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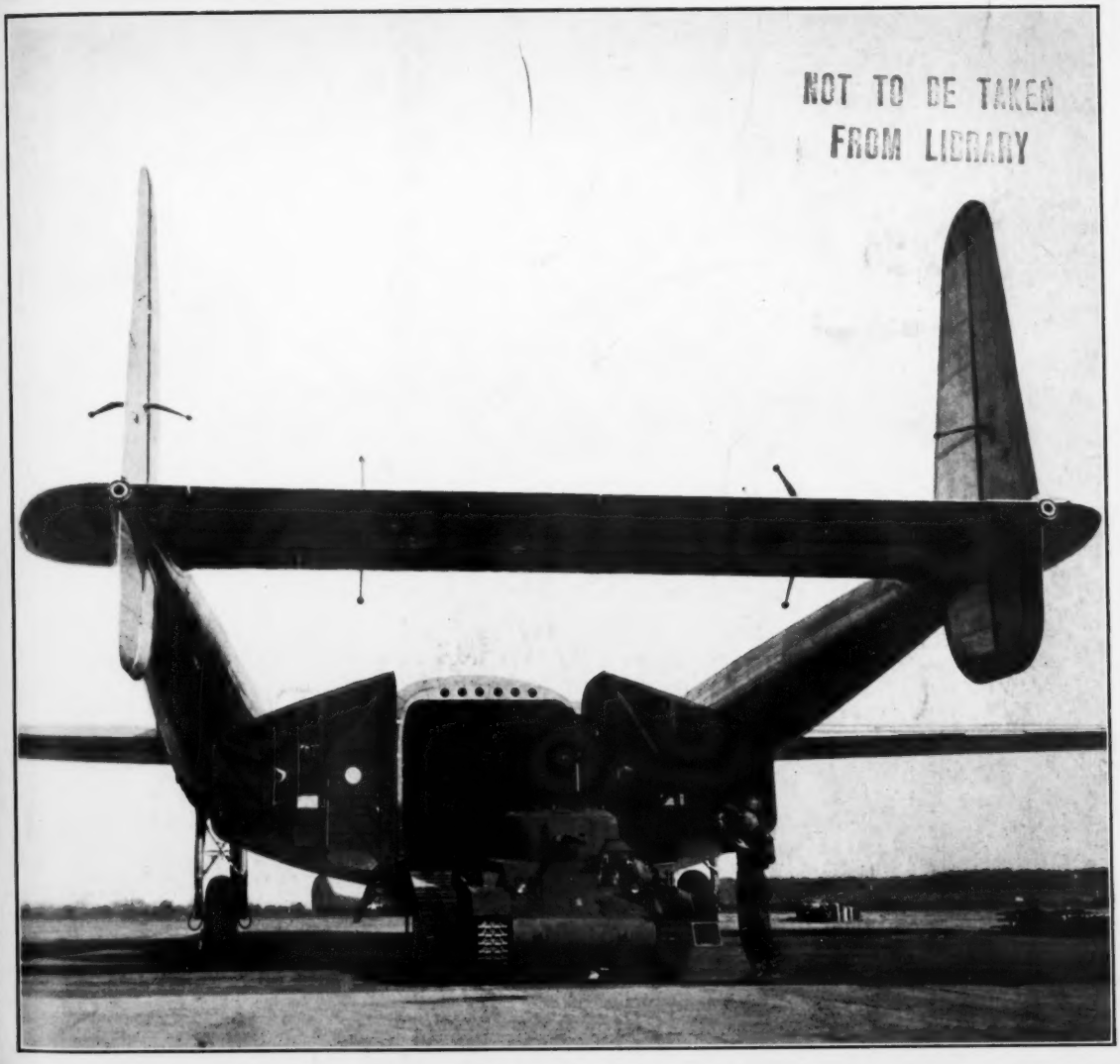
AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

DECEMBER 1944



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But help was coming to the nineteen that day. Their buddies were on the job. From the Coast Guard Air Station at Elizabeth City, North Carolina, Kingfisher Scout-Observation seaplanes had been on ceaseless patrol. Coast Guard methods are thorough. Systematically, its planes and ships comb every square mile of our vast ocean fronts. So the great moment came at last to the brave men of the *Jackson*—the moment of discovery and swift aid.

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* * *

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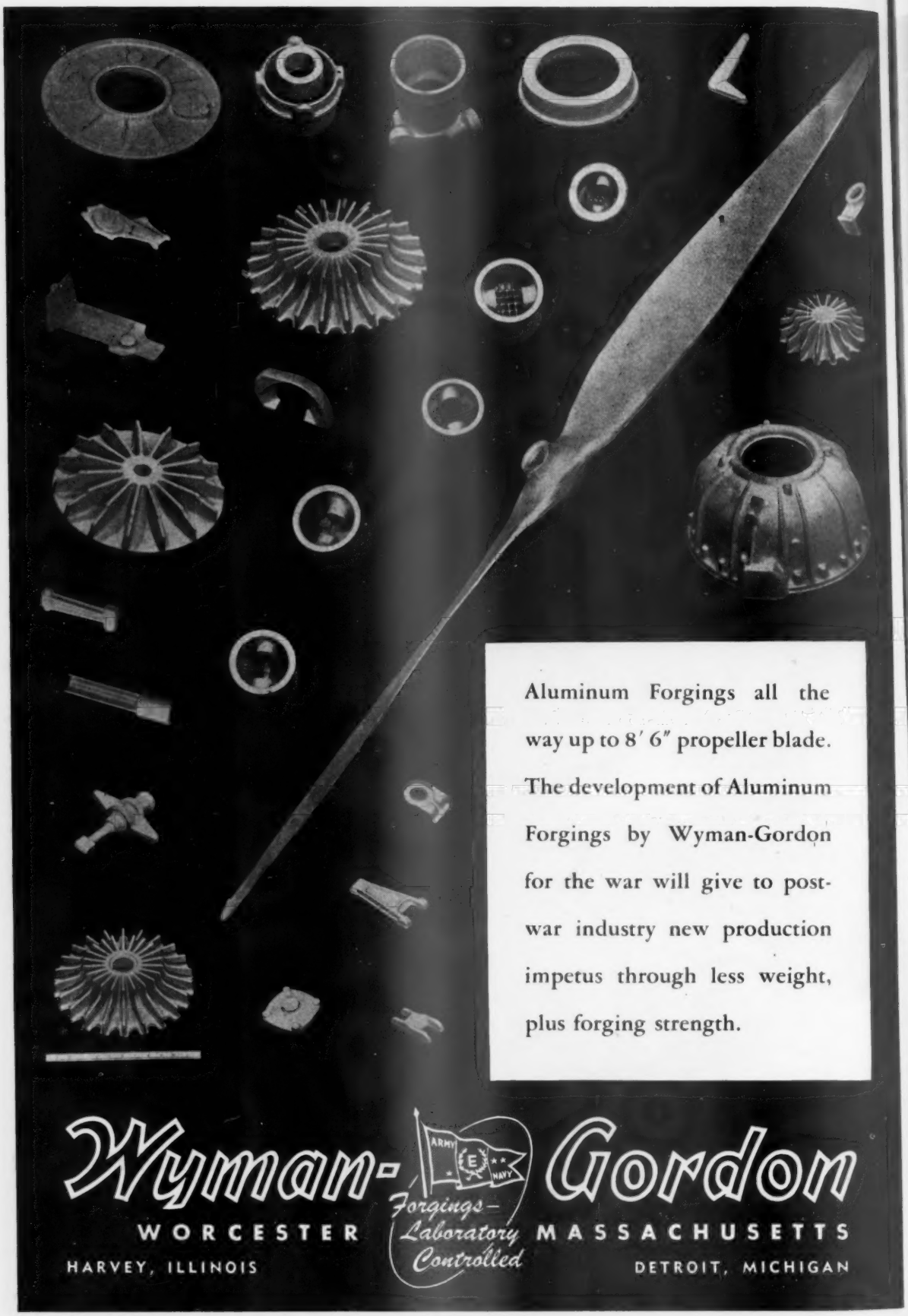
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December, 1944

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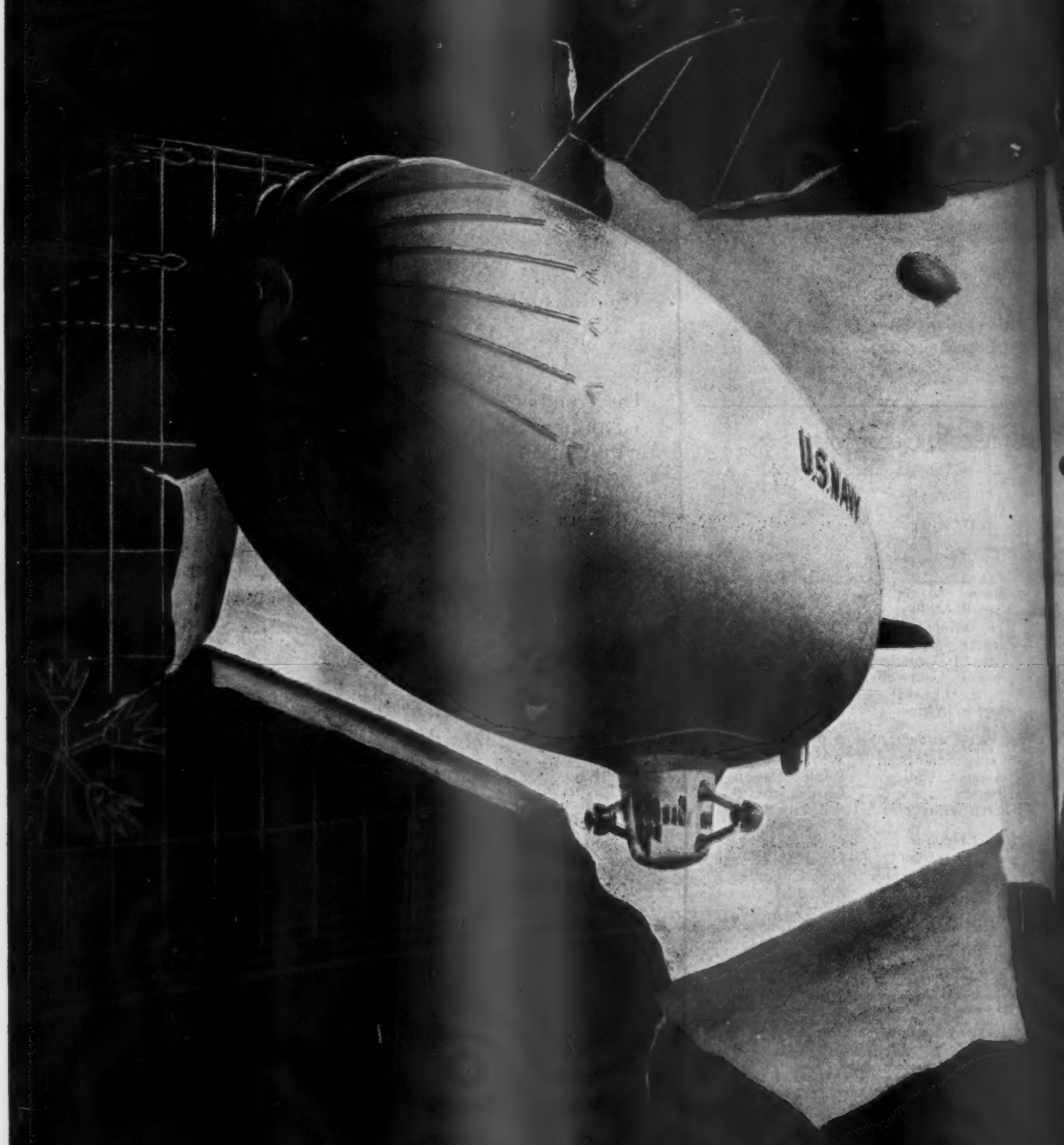

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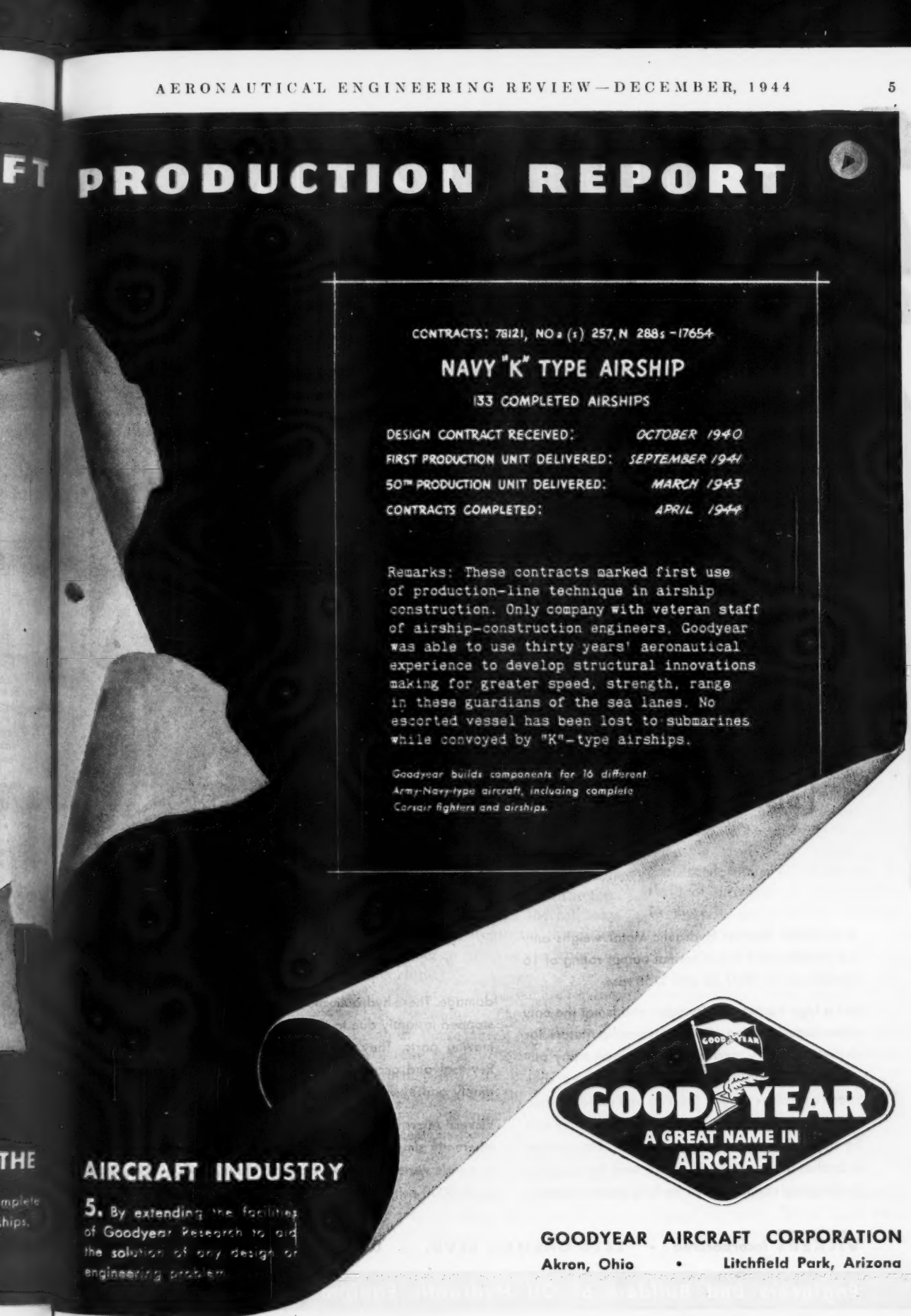

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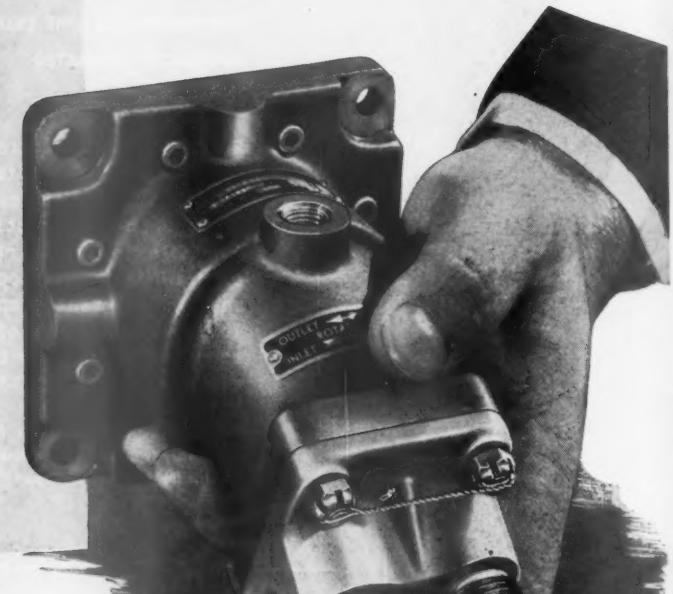

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Training for Higher Levels

(A Guest Editorial)

W. F. DURAND*

National Advisory Committee for Aeronautics

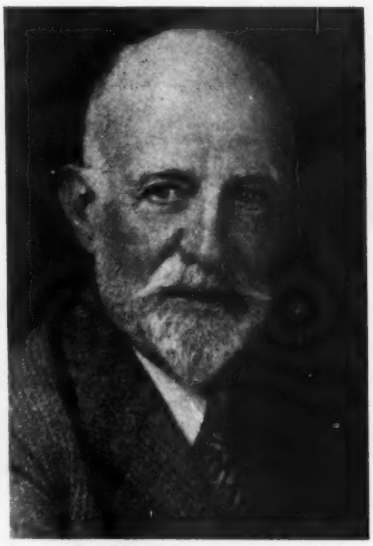
WHO, 40 years ago, could have foreseen or even dreamed of the part now taken in great world affairs by air transport? Who now is wise enough or bold enough to hazard the picture 40 years or even 20 years hence?

This great enterprise of air transport will call for a vast army of human units, organized on all levels of human activity, from what we term low to high. Numerically, by far the greater number in this vast army will fall into the first category—those who serve through trained muscular effort or by the immediate supervision of such effort. But as an equally important part of the picture, this vast army of operatives must be organized and guided by higher supervision and direction, reaching up into the top-flight executive positions and their immediate assistants. Here, then, is a great field of human engineering.

There will be high executives for the determination of policies and programs; aids to see that these are carried out in detail; designers for the creation of new forms and the development of new ideas and a continual advance in the quality of product; scientists and researchers for the study of puzzling problems; inspectors and test engineers to insure the proper quality of the material employed and of the resulting product.

For those who have some measure of advanced technical training, for those who are likely to read the pages of this journal, it is reasonable to expect that they will find a place in this great army, somewhere on what we call the higher levels—those dealing with supervision, research, design, executive direction.

*Member, N.A.C.A.; Professor Emeritus, Stanford University.



To all young men now in the age class of twenty to thirty years, it should be a challenging and stimulating thought that, at a period ten, fifteen, or twenty years hence, upon them may rest the responsibilities of the executive direction of these manifold activities, through all degrees and levels up to the top. No one can tell when the call may come, what accidental condition may bring to his door the knock of opportunity.

What about preparedness for this high mission? There must, of course, be technical qualifications. We take these for granted, varying naturally with the particular task in question. But the efficient executive needs something more than technical competence.

The importance of the widening in the vision of the executive might be developed at great length, but there is no space here for an extended discussion of the matter. The stark fact remains, however, that the manager, the executive, must be something more than a technician.

Is there not here, then, a challenge to young men in the aircraft industry to begin to think of these things? Upon some of them must rest management in the course of a few years. Should not this be a spur to a beginning of serious preparation for these high obligations? No matter how absorbing the technical demands of the day's work, there should be left some residuum of interest and energy which could be turned toward the study of these matters. Reading, night-school courses, discussion, observation, reflection; all of these will aid in the widening of competence toward higher and higher levels in the hierarchy of our industrial enterprises.

Do not for a moment understand these admonitions as in any way constituting advice to neglect progress on technical levels of the work. The executive must keep abreast of the advances on all engineering and scientific levels with which he is concerned; but to share in the thrill of direction or management, to share in the executive function, he must widen his horizon.

To the young technician, the research worker, the designer, the experimentalist, the supervisor or leader of a squad: say to yourself, "In the course of a few years there will be on the higher levels of direction and management, men of my age and with the same general level of technical competence. Will I perchance be among the number selected for such larger responsibilities?"

Do these wider levels of activity appeal to you? They have their rewards and their griefs. They have duties and responsibilities which must be assumed and carried. If they have appeal, gird yourselves for the task.

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To introduce professional standards of design and performance in transmitters and receivers for radio hams in the early thirties.

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*The Collins Autotune is a repositioning mechanism which quick-shifts all transmitter or receiver controls simultaneously and with extreme precision to any one of a number of pre-determined frequencies. U. S. Patents issued and pending.

ARMY E NAVY

COLLINS

The Trend of Wood Use in Aircraft

ROBERT W. HESS*

Curtiss-Wright Corporation

Present Status of Wood Use in Aircraft

The pattern of wood use in production aircraft of the United States is becoming sufficiently stabilized to permit some analysis of its present status. In this country a high percentage of single-engined primary trainers are constructed all or in part of wood. Plywood is being used more frequently for the wing and fuselage surfaces on this type. The twin-engined trainers made of wood are competing on fairly even terms, with respect to the number of successful models, with the metal types. All-wood pursuits, bombers, cargo, and transport types either have not reached accepted production stages or do not exist. Gliders, both of the trainer and the transport-cargo types, tend toward wood construction throughout.

While other countries generally use more wood parts in their metal aircraft, the relationship of all-wood construction to all-metal construction approximates that of this country. Presumably, all-wood trainer airplanes are popular in all countries. Few successful wood pursuits or bombers have made their appearance. Cargo and transport types are either completely or predominately metal. The Russians have an all-wood single-seater fighter, the LAGG-3, with a maximum speed in the order of 360 m.p.h. They also have two other fighters, the MIG-3 and the JAK-1, in which major components are wood.[1] The eminently successful fighter bomber of the British, the Mosquito, is the present standard for optimum wood aircraft construction. The Germans use gliders of wood or part-wood construction. The Airspeed Horsa, Great Britain's largest glider, is of plywood construction.[2]

The use of plywood parts on metal airplanes is more difficult to summarize. The ever changing requirements of global war, continual design improvements, and service reports from all parts of the world bring overnight changes in the use of special materials for parts. Among the plywood parts that are, or have been, successfully used on metal aircraft are trim tabs, ailerons, wing tips, and flaps. In more common usage are doors, flooring, cargo ramps, fairings, cable guards, and bomb bay doors. Troop benches and pilot seats have been used to some extent. Wood and compreg wood propellers are used extensively by the British and the Germans and to a much more limited extent by the United States.

It is interesting to note that plywood flaps, trim tabs, and ailerons have been used on metal aircraft while the same units constructed of metal have been used on essentially all-wood aircraft. Superficially it appears that the excellence of design may outweigh the advantageous properties of a given material in these instances.

Factors Influencing the Use of Wood in Aircraft

The history of the use of wood in aircraft has been discussed many times. The date of wood's recession and aluminum's rise to dominance in aircraft construction is generally set at about 1925. The strong return of plywood as a competing structural material, both in fact and in voluminous publicity, can be set at about 1940. During this period of eclipse the "art" of constructing good wood airplanes was largely lost. The comparatively few skilled designers were scattered through the industry and commonly applied their talents to design in metal. A few notable exceptions occurred, particularly in the light plane field where certain companies continued development work in wood.

Experience in Wood Aircraft Design

Perhaps the greatest deterring factor in the use of wood for aircraft lies in the fact that most engineers have had little or no training in its use. Relatively few have had practical experience in wood aircraft design or manufacture. This dearth of experienced personnel was an unfortunate handicap at the beginning of the war when the opportunity arose for more extensive application. All too frequently structural units have failed under low test loads because of an improperly designed small part. It is highly probable that the grave shortage of detailed designers capable of excellent design work in wood contributed greatly to relatively mediocre test and performance characteristics of a number of wood aircraft developed in the last 3 or 4 years.

The fundamental cause of aircraft design troubles in wood lies with the extreme shortage of data on strength and elastic properties of wood. Poor detailed design practice can be traced to engineers who have not had the experience that can be gained through the trial and error of previous constructions. However, that cannot excuse the lack of fundamental data that would have permitted closer initial estimates of properties. Part of these data have been assembled in tables of properties of small clear wood test specimens. Until the fairly extensive program was initiated in 1942 few data were available for various plywood and laminate combinations and shapes. Even now the detailed fundamental data and basic design information suitable for wood aircraft construction are extremely scanty as compared with data available for aluminum alloys or steel.

The problems of producing the most efficient design for a wood structure should not be minimized. These complications are inherent in an orthotropic material whose directional properties differ so markedly in opposing directions. The very multiplicity of formulas (e.g., six Poisson's ratios, three Young's moduli) introduced by the directional properties increases the difficulties of designing. Experience, however, permits selection of limiting properties.

Effect of Stress Concentrations

The critical effect of stress concentrations has been extremely troublesome in wood structural design. Particular points of difficulty have been at bearing points for bolts, at cutouts in a composite structure, in certain types of panel loadings, and where heavy solid members are joined to thin plywood panels. Commonly, the difficulty arises when the designer uses the compressive strength or shearing strength parallel to the grain of the wood only to find that because of irregularities of loading, of stress distribution, or of grain direction only a portion of this strength can be used. The limiting factor then becomes, at least in part, the compressive strength perpendicular to the grain or (in the case of shear) tension perpendicular to the grain, which are only about one-third to one-sixth of the parallel val-

Presented at the Aircraft Production Session, Twelfth Annual Meeting, I.A.S., New York, January 25–27, 1944.

* Head of Wood and Plastics Research.

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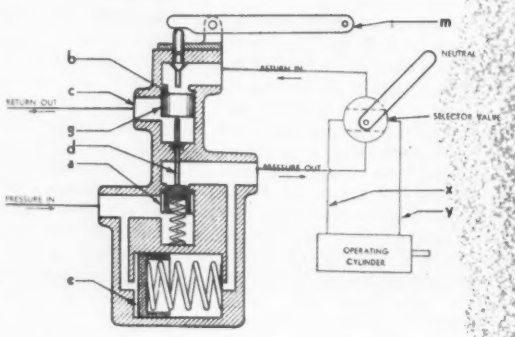

A check valve (a) is inserted in the pressure line between the power system and the selector valves. A displacement cylinder (e) is placed in parallel with the check valve (a) so that a sample of fluid may be discharged downstream from the check valve even though the valve be closed. When this sample is directed through a selector valve to an operating cylinder, it initiates movement of the piston in that cylinder thus displacing fluid from the other end. This returning fluid enters a small hydraulic cylinder (b) and moves its piston (g) before escaping through port (c) and to the reservoir. The motion of piston (g) is transmitted by push rod (d) to the check valve poppet and lifts it from its seat. Now that the check valve is held open fluid can flow through it and continue moving the operating cylinder piston. If the return line from the operating cylinder had been broken the sample would have moved the operating cylinder piston a small amount but the displaced fluid would have run out the break and thus not acted upon piston (g). Therefore, the check valve would not have been opened and flow of pressure fluid would have ceased as soon as the sample was used.

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ues. Frequently, small changes in design detail could have been used to avoid the stress concentration.

Further complicating the shortage of fundamental test data has been the problem of static test of completed wood structures. The time factor involved in imposing the test load and in measuring the deflections has tended to reduce significantly the ultimate attainable. Although the general relationship of moisture content to wood strength is known, the standard practice does not require control of atmospheric humidity or tests under extreme moisture conditions known to occur in service.[4]

The relationship of specific gravity to the strength properties of wood is now generally recognized. A partial control is attained through limitations imposed by specifications, but these permit a range of variation of from 20 to 28 per cent.[5] Much closer control of the range of variation could readily be maintained by the producer of air craft lumber and veneers and would give a corresponding reduction of weight and strength variation. (A similar improvement could be maintained in the veneer tolerances.) Undoubtedly, during normal postwar years, certain producers can supply aircraft veneers and lumber to close specific gravity and thickness tolerances.

Hygroscopicity of Wood

Another important source of difficulty with wood aircraft structures is caused by the hygroscopicity of wood. Troubles generally appear as wrinkling of large, thin unsupported panels and weight increase due to excessive moisture absorption or loosening of metal fittings on heavy solid members because of shrinkage caused by excessive moisture loss. Much of this type of trouble can be avoided during the designing. Close attention to balance of veneer thicknesses would eliminate much of the panel distortion. (A number of the constructions specified under aircraft plywood specification AN-NN-P511b are not well balanced.) Fortunately, balanced construction of plywood, which has equal thicknesses of veneer lying directionally opposite to each other and equidistant from the center, is also favorable from a stress distribution and stress reversal standpoint. Minimum sizes of unsupported panels must be determined for a given thickness of plywood. Similarly, much of the shrinkage difficulty encountered with thick members can be reduced or eliminated.

The type of finishing material used on wood aircraft is inseparable from the effect of moisture content on the strength and stability of the wood parts. As yet no perfect finishing material is available for wood. The effectiveness of the better materials varies with their weight so that minimum thicknesses or reduced numbers of coats may invite the moisture problems mentioned previously, not to mention the resultant lack of permanence in the finishing coat itself. As more experience is obtained and better finishing materials appear, it should not be difficult to minimize these effects by correlating the minimum coating necessary to exclude virtually all of the moisture during the relatively short high humidity cycles of given exposure conditions.

In addition to the problems of wood aircraft construction which are characteristic of the material and its known properties, the adverse results brought about by the wartime conversion of the wood industries, including all sorts from the furniture to the "hogs-head" manufacturer, must be mentioned. With little or no training period available these industries could not be expected to produce aircraft parts to required tolerances, with adequate moisture and quality control Many of them learned quickly and soon turned out parts of high quality throughout. In other instances the personnel, equipment, and previous experience did not readily convert to the exacting methods required for quality aircraft. It is unfortunate that these manufacturing inadequacies have, on occasion, been pointed out as limitations in the use of wood.

Advantages of Wood

Lest the enumeration of the major problems weigh disproportionately in the discussion of factors influencing the use of wood in aircraft, it may be well to enumerate a few of the advantages of wood as compared with metal structures. The particular feature mentioned as an advantage is expected to apply only to specific cases and is rarely applicable generally. In such applications as the fuselage, the *appearance* of a molded plywood structure will be much better than that of a tubular metal and fabric combination or of minimum gauges of sheet metal. A distinct *weight-saving* will be obtained in lightly stressed parts where the minimum gauge of metal is that which will give the required stiffness. Definite savings in *cost* will appear in certain plywood units that can be fabricated in few parts with relatively few internal members. Costs will generally favor plywood parts where an appreciable amount of stiffening construction can be eliminated as compared with a similar metal part or where the fabrication or tooling costs of the metal part are comparatively high. *Rigid airfoil sections* of plywood, molded to shape with small tolerances, will be an advantage in particular instances where these qualities appreciably affect the aerodynamic efficiency of the part. The *vibration dampening* properties of wood may solve a particular application problem. The excellent *soundproofing* and *insulation* properties obtainable without extra weight offer an advantage for fuselage construction.

Developments Foreshadowing More Diversified Use of Wood in Aircraft

During the last few years a number of striking developments in the methods of using wood have greatly improved the prospects of wood application in the near future. Some of these new developments have been overpublicized in their early stages with a typical disappointing reaction when they did not prove equal to initial laudatory description. Many of them can be considered to be in the early exploratory stage, with test and service data being collected to determine optimum applications. The urgency of the war, together with the unselfish cooperation of industry, has pushed some of the material and process developments to general acceptance for production in a matter of months as compared with usual development period of 2 or 3 years.

Adhesives

Perhaps the one most important recent development was that of the synthetic resin adhesives. These materials for the first time permitted weatherproof bonds of wood which remained stronger than the wood itself. Also of great importance was their ability to "set" with great rapidity upon the application of heat, thus permitting the use of relatively new forming and bonding processes. The numerous types of adhesives and their respective properties have been discussed at length in various publications. A brief recapitulation of the types and the state of their present development may not be amiss, however.

Numerous types of excellent thermosetting adhesives have been developed to fit various conditions of bonding. These can be classified as to predominate chemical composition (urea-formaldehyde, phenol-formaldehyde, melamine, and resorcinol) or according to the temperature range in which the adhesive is designed to polymerize ("set"). The cold-setting adhesives, designed to set at room temperatures, are commonly used for assembly work. Cold setting ureas are commonly used for this application, but newly developed phenolics and resorcinol adhesives threaten to supersede the ureas because of their superior durability and strength. A moderate-temperature-setting group of adhesives is available with properties peculiar to the needs of the bag molding process. This group of adhesives sets within a wide temperature range of from 150° to 280°F. and includes both ureas and phenolics of excellent properties. The hot-setting adhesives bond virtually all of the aircraft flat panel plywood and to a lesser extent the bag molded material. This class is the oldest of the synthetic resin adhesives and is also responsible for the most durable and reliable bonds. The bulk of the hot press bonding for aircraft materials is done with the phenolic resins, either film or liquid, with only a moderate amount of urea and a small amount of melamine adhesives being used.

As a type, the thermoplastic resins have as long a history in modern wood aircraft construction as do the thermosetting types. The tendency of these types to flow at temperatures within the range of possible service temper-

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atures put them in early disfavor despite their superb adhesive qualities. Recently, however, the flow temperature of some types have been raised close to service requirements. Already used in production is an excellent product of the chemists' alchemy purporting to be a thermosetting-thermoplastic type. Undoubtedly there will be more improvements of this type of adhesive, which offers the advantage of characteristically excellent adhesive properties together with a more resilient adhesive layer than characterizes the thermosetting types.

Unquestionably the greatest recent improvements in the wood adhesive field are now being made in the low-temperature and cold-setting groups. New phenolics, resorcinols, and possibly other types promise to give improved bonds in assembly work.

The most promising of the recently developed adhesives are the new wood-to-metal bonding materials. The best of these materials develop bond strengths well above the shear strength of any wood. Extensive use of wood-metal bonding is certain to take place. The possibilities of eliminating much of the excessive weight penalties of bolted fittings are most encouraging. Pickup and distribution of concentrated stresses will be greatly simplified by the bonded metal (or plastic) plate.

Bonding Methods

Bonding of wood parts together with synthetic resin adhesives is accomplished by simultaneous application of pressure (15 to 250 lbs. per sq.in.) and heat (70° to 310°F.). Uniform distribution of the pressure over the entire area to be bonded is a basic requirement and a continual problem in the production shop. To obtain adequate and uniform pressure distribution there has been a general trend away from the use of "C" clamps and nailing strips. There is also a continuing increase in the use of heat to accelerate the "setting" of the adhesive, both for increased production and to reduce the time—and attendant risk—during which pressure must be held constant. The use of heat also improves the bond quality of many synthetic resins.

Fluid pressure application in the form of flexible hoses or diaphragms has come into widespread use for aircraft parts assembly. This method permits positive pressure application on curved surfaces and tends to eliminate the pressure application troubles caused by surface irregularities. Gauges are used for pressure measurement, a great improvement over estimated pressure derived from screw-type or nail-gluing applications. Ingenious clamping jigs with spring arrangements for maintaining pressure have come into use where sufficient heat can be applied to permit a short bonding cycle.

A number of developments have appeared for applying heat to a gluing assembly. Perhaps the most practical from the standpoint of easy application has been the resistance-type electrical heater. These heaters are usually made up in the plant to fit the particular application. Commonly, strips of sheet or foil metal are used; isolated applications of screen or wire strands have been reported. The use of an extremely fine screen within the glue layer is successful for adhesive bonding but of doubtful value in aircraft work. The use of the glue film itself as the electrically resistant medium has not yet been developed for general production. Infrared heating has introduced localized drying problems and, although successful, is generally limited to small areas.

The most dramatic of the heating methods developed recently has been the radio-frequency electrical method. It is somewhat early to predict the extent to which this device will be applied in aircraft gluing. For thick sections, such as laminated spars and bulkhead material, this method is easily the best available. Apparently the radio-frequency method can also be applied advantageously to large production of thinner parts to which heat cannot be readily applied by other means. (Certain parts assembly operations fall in this category.) At the present time it is doubtful whether the radio-frequency machine can compete economically with ordinary steam or strip heater methods where the glue layer is close to the surface or the total number of parts is relatively small.

The net results of these advances in gluing methods can be summarized as: (1) increased production without a corresponding increase in the number of jigs and floor space; (2) decrease in cost; (3) an improved product through more exact control, decrease in clamping pressure time, and (often) improved quality of the cured glue film.

Forming Methods

Much of the impetus for the rapid expansion in plywood use was obtained from methods of forming the plywood to shape as the layers were bonded. The well-known bag molding process is the most noteworthy of the various methods. Recently, a number of other forming methods for simple and compound curves have been developed to reduce the time cycle and cost of the standard autoclave (pressure cylinder) and rubber bag processes. Some of these use pneumatic pads on hydraulic presses; others use a rubber diaphragm forced by steam or air pressure against the work. Ingenious jigs or clamping forms are frequently used to construct one specific part without the use of a fluid pressure device for general application. Matched dies have been used extensively only where the production quantity was large, such as for standard angle or hat-section shapes. The low pressure obtainable with the vacuum bag alone has prevented its extensive use.

Wood, cement, and plastic materials are used for forms. Self-heated matched concrete forms are sometimes used to apply both the pressure and the heat to make plywood shapes.

A great many of these forming methods and devices have proved valuable for low-cost production of plywood shapes. A number are being improved even more by the addition of improved heating devices. More extensive application of formed shapes and variable thicknesses is thus made possible without excessive costs.

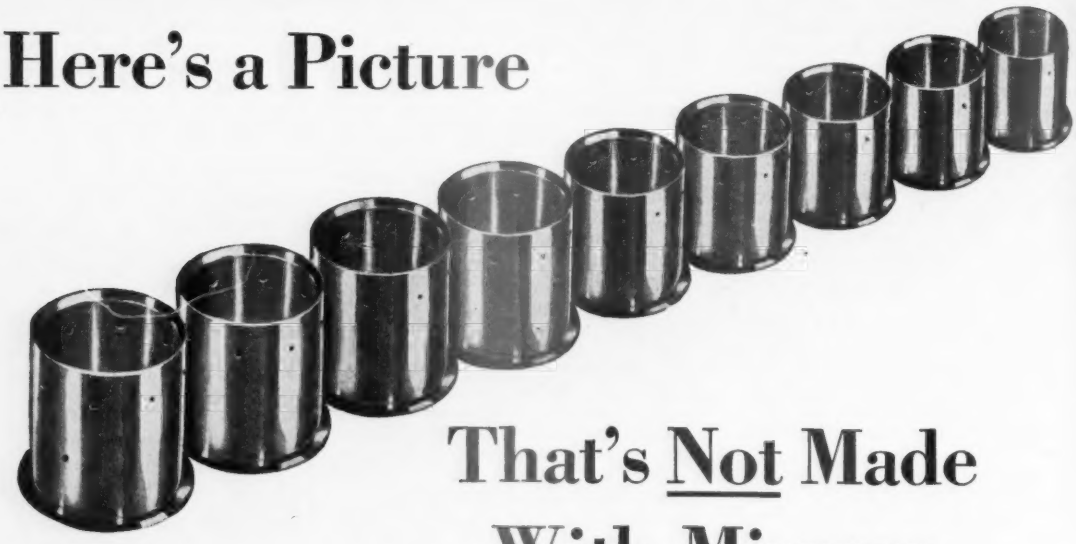
Materials

Many new material modifications and combinations have recently been made available for use in the wood aircraft field. Careful study of their properties and skillful application of them will eliminate many of the problems of wood use discussed earlier in this paper. This study and application will have to be made for the most part by the aircraft industries and not by the material vendors.

The use of synthetic resin impregnated wood (called "impreg") appears to offer considerable advantage. By impregnating the veneers with a synthetic resin (usually a phenolic type), practically all of the troublesome shrinkage and swelling normally occurring in wood aircraft parts in service can be eliminated. Furthermore, the impregnation takes place while the wood is in veneer form, thus eliminating subsequent finishing needs, both internally and externally. Unfortunately, there is an attendant weight increase that is not entirely offset by a corresponding strength increase. The major strength increase is in compression, however, which is the weakest design property of structural plywood. It is possible to use only a partial impregnation throughout or to impregnate only surface veneers in those parts not requiring complete dimensional stability. The weight differential can be further offset where advantage can be taken of the increase in compressive strength (about 20 per cent increase at maximum practical resin concentrations) to decrease the thickness of wood required. The omission of part or all of the finishing material also offsets a considerable part of the added resin weight. While it may not prove feasible to utilize this material throughout the entire airplane, it seems probable that it can be used in many places to eliminate difficulties arising from normal shrinkage and swelling. Impreg may prove particularly useful for the construction of wood parts for metal airplanes, thus eliminating stability problems that are sometimes encountered when wood and metal are joined.

When resin-impregnated wood is compressed a densified material called "compreg" is produced. Similar dense materials are produced by variations of this process. This material has been used to a limited extent in aircraft frames, mostly as bearing plates for bolts, bearing pads, and various high-strength inserts or small parts. Its major use has been for propellers. As with most new products the initial uses proposed for compreg were too optimistic and subsequent verdicts too pessimistic. There are a number of highly specialized uses for which a form of compreg may well prove advantageous.

Here's a Picture



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In most of these applications a considerable amount of care must be used in the design to eliminate stress concentration, particularly where compreg is used adjacent to wood of distinctly different properties. Often extreme differences in moduli can be minimized by separating the materials with a thin layer of high-density wood or by reduction of the density of compreg used. A most intriguing application proposed for compreg is its use as hard, highly polished, durable external surfaces for aircraft parts. It would be a relatively simple matter to produce a compreg surface a few thousandths of an inch thick on molded plywood parts.

A careful study of the various strength/weight relationships of our native woods will bring out the fact that superior materials are available for particular applications. There is no logical reason for not using a number of these species to obtain more efficient structures. Combinations of some of these species into composite laminates might prove more favorable for some uses than the more common, and not infrequently misused, aircraft woods now employed. A survey of the many species of wood available in the American tropics might reveal some with markedly superior properties. A great variety of properties are available among the tropical woods, as can be evidenced by the range of weights from 3 to 83 lbs. per cu.ft.

Laminate combinations of wood and plastics have been used to a limited extent. Preliminary studies indicate that certain combinations may be extremely efficient. Many of the problems of wood construction discussed previously apply to these combinations with even less information available for design purposes. A considerable development period will apparently be required before these materials find wide application.

Wood and metal combinations made practicable by recently developed adhesives are expected to reduce greatly the weight of the metal fittings required in wood aircraft. Present metal fittings must be inordinately large with numerous bolts. Metal plates or fittings cemented to the surface or built into the wood laminate make use of much larger areas for stress application. More extensive use of cemented metal parts has been deterred by the complicated stress concentrations involved in this combination. Entirely new designs are required for most cemented metal to wood fittings. When the design problems have been solved we can reasonably expect wing spar attachment fittings to be built into, or cemented onto, the laminated wood spar, metal bearing plates cemented over each bolt hole, cemented and riveted piano type hinges, cemented metal rims on inspection openings, thin metal coverings on parts of cargo floors, and many similar applications. Considerable study will be required, but the use of wood-metal cements should eventually develop into one of the most notable recent advances in the use of wood in aircraft.

Design Data

Perhaps the most significant development of all has been the accumulation of a considerable amount of test and design data. While the bulk of the work has been done at the U.S. Forest Products Laboratory, other organizations have contributed appreciably. In conjunction with the applied data developed by the various aircraft companies, the basic data exist in sufficient quantity to permit much more accurate design of wood structures than was possible at the beginning of the war. It is hoped that the accumulation of this information will continue actively following the war.

Probable Development and Extent of Future Use

Acceptance of plywood or combination plastics and wood aircraft parts will be on the basis of relative merit from the standpoint of weight, structural efficiency, and cost. The competition from metal aircraft parts will be intense with all but marked advantages being discounted in favor of the material with which the engineering staff has had the most experience. Optimum efficiency and minimum cost requirements will direct the development of aircraft toward the composite structure constructed of metal, plastics, and wood.

It is, of course, hazardous to make predictions of future usage. The attempt, however, presents a clearer picture of the dynamic changes that are taking place than does a static description of present conditions.

The use of wood and compreg wood for propellers will meet extremely strong competition from the metal types. There should, however, be a consistent demand in the light airplane field and a small erratic demand for large blades. The use of this type of blade in the United States will be much less than in England and the European countries because of the prejudices that have been built up against the wood propeller in this country.

The use of wood for unit aircraft parts should be more widespread following the war. Unquestionably, usage will continue erratic throughout the industry. There will probably be considerable application of plywoods in panels, doors, and other internal parts. The thick, lightweight panels that can be built up are particularly promising as flooring materials. External parts of plywood on metal aircraft will be those lightly stressed parts where minimum skin thicknesses are the rule. These include wing tips, vertical fins, rudders, stabilizers, and elevators. Plywood flaps may be used where weight-savings can be obtained. Ailerons and trim tabs of plywood or combinations will probably be used on a number of aircraft to obtain better performance or to reduce weight.

Gradually the merciless decisions of a highly competitive postwar market will shape the pattern of materials to be used in aircraft. Reasonable guesses for the major wood aircraft applications in the immediate future would be:

(1) Medium-sized metal transport and cargo airplanes should have some plywood parts.

(2) A limited portion of the small passenger and cargo aircraft (10,000 lbs.) of predominately wood construction.

(3) A high percentage of the small private passenger and trainer airplanes of plywood or plywood-metal tubing-fabric combinations.

(4) The bulk of the gliders should be constructed of wood, frequently in combination with metal and fabric.

(5) Plywood fuselages should be used on a substantial proportion of the helicopters.

Summary of the Development Trend

During the last 3 years the application of wood to aircraft has gone through a cycle of intense interest and active development and back to a more moderate study and application. The short time involved and the abnormal demands of the war discount many of the results and conclusions reached during the period. The general stages of the cycle and its influence on the future use of wood in aircraft might be summarized somewhat as follows:

(1) Possible future metal shortages and the anticipated need for a great variety of aircraft types stimulated development of numerous wood aircraft designs at the beginning of the war.

(2) A reasonable number of these designs were proved and put into production. Numerous problems arose during designing, fabrication, and testing of some designs, however. These problems were largely caused by:

(a) The lack of sufficient experienced wood aircraft designers and detailers.
(b) The absence of adequate basic design data on wood, plywood, and laminates.
(c) The shortage of wood fabricators experienced and equipped for aircraft production.
(d) The unwillingness of the veneer, plywood, or lumber industry to impose as close control and small tolerance as possible on their product.
(e) Almost no experienced wood aircraft parts and fabrication inspectors available for expanded production.
(f) Insufficient time available to build up the required information and experienced personnel.

(3) During the present time a recession is occurring which will place the relationship of wood aircraft to metal aircraft in the postwar period approximately in the status it now enjoys, with these advantages: (a) existing aircraft types and parts developed through the war period, and their attendant reputation; (b) a nucleus of well-trained wood

(*Continued on page 29*)

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Application of the Variable Ratio V-Belt Principle in the Design of a Constant-Speed Propeller

LLOYD H. LEONARD*

Zimmer-Thomson Corporation

SUMMARY

The need for an inexpensive reliable constant-speed propeller, suitable for engines of small and moderate horsepower, is briefly discussed. A short history of the development of the ISO-REV propeller, intended to satisfy this need, is presented.

The operating principle of this propeller is described in detail, and its functional parts are clearly illustrated by a simple schematic sketch. Control characteristics are discussed with special reference to the inherent freedom from hunting which is characteristic of the variable ratio V-belt principle. A technical study of the reaction of the control mechanism to off-speed conditions is included, together with a graphical illustration of the relationship of forces. Practical results of extensive tests of an experimental ISO-REV propeller are analyzed.

It is concluded that the variable ratio V-belt principle, when applied in the design of a governor mechanism, makes possible a simple, reliable, inexpensive constant-speed propeller, particularly suited to the requirements of small and moderate horsepower.

INTRODUCTION

THE NEED for an inexpensive, reliable, constant-speed propeller, suitable for engines of small and moderate horsepower, has been widely recognized for many years. Notwithstanding their universal use on expensive, high-performance airplanes, constant-speed propellers were virtually unavailable in the light airplane field before the war. Builders and users of small airplanes, nevertheless, were well aware of the substantial improvement in performance that would result from the substitution of such a propeller for the usual fixed-pitch type.

At the beginning of the present war emergency the Army Air Forces were alert to the military need for a constant-speed propeller suitable for the newly developed, moderate horsepower, quantity production engines. Contemplated high-performance airplanes, designed around these engines, depended for their success on an efficient conversion of

power into thrust. Accordingly, the Army Air Forces began actively promoting the development of a satisfactory moderate horsepower constant-speed propeller.

Certain basic requirements were specified. The desired control speed was to be selective during flight over a moderately wide range, simulating the performance of conventional large constant-speed propellers. Moreover, the control mechanism was to respond quickly to all disturbances and consistently maintain the selected control speed to within close limits. Preferably, the operating mechanism was to be a self-contained unit not requiring auxiliary power sources. The complete assembly was to be as compact and light in weight as ease of construction and reliability of performance would permit. Finally, low cost or, more specifically, a small required number of man-hours of production time for each propeller was to be the keynote of the whole design. This was a large order, for it required, in effect, that the essential performance characteristics of conventional large constant-speed propellers be duplicated in a simple, self-contained unit adaptable to quantity production at low cost.

It was evident from the outset that a basic new principle of operation was needed to satisfy these requirements. Adaptation of conventional types of constant-speed control mechanism appeared to offer little hope of a satisfactory solution. Conventional constant-speed propellers unquestionably are marvels of mechanical excellence, but, unfortunately, they are inherently complex and require considerable precision manufacture. Hence, they are prohibitively costly except for expensive airplanes. It is apparent that scaling down their size, together with possible simplification of details, would not make possible the required small number of man-hours of production time. Moreover, the adaptation of certain types of conventional constant-speed control mechanism is further handicapped by the requirement of auxiliary electrical or hydraulic power sources that generally are not adequately available in small airplanes.

In view of these considerations, therefore, there was an obvious need for a basically new type of constant-speed propeller specifically suited for moderate horsepower requirements.

DEVELOPMENT OF THE ISO-REV PROPELLER

It was with a determination to satisfy the above requirements that the development of the ISO-REV propeller was started. Contributions by R. C. Magee and other Air Force personnel of the Propeller Laboratory, Air Technical Service Command, Wright Field, in connection with the basic concept of the control principle are duly acknowledged. As a first step, a small working model was built to demonstrate the soundness of the basic control principle. The performance of this model exceeded expectations and resulted in the design and construction of a full-scale wood blade propeller suitable for an engine of about 285 hp.

The control mechanism of this first experimental propeller functioned when the propeller was first tested, but the response to off-speeds was not considered so rapid as was desired. After further extensive experimentation and a few modifications in design, however, the performance was considered satisfactory and the propeller was subjected to engine and flight tests at Wright Field. The present production model of the propeller is based on this original experimental design.

OPERATING PRINCIPLES

The energy of the rotating propeller shaft is utilized to achieve the necessary

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* Chief Engineer.

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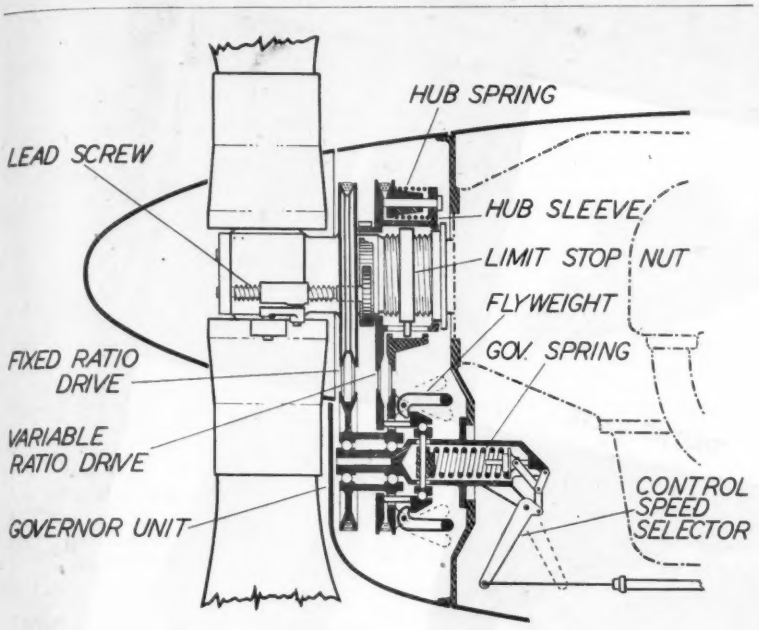


FIG. 1.

pitch changing action. The control mechanism, therefore, is a self-contained unit and does not require an auxiliary power source for its operation.

Pitch Changing

Basically, pitch changing is accomplished by utilizing the controlled difference in ratio between fixed and variable ratio drives. A governor unit mounted on a fixed shaft is driven at a function of engine speed by a fixed ratio drive, and, in turn, a sleeve on the propeller hub is driven from the governor unit by a variable ratio drive. Changes in the final drive ratio are controlled by a speed sensitive flyweight governor in accordance with the requirements for maintaining a preselected constant propeller speed. The schematic drawing of Fig. 1 illustrates the general arrangement of parts. Fig. 2 shows a demonstration model of the mechanism.

Pitch changing occurs whenever the sleeve on the propeller hub turns either slower or faster than the hub, gear-driven lead screws being employed to transmit the resulting speed difference into pitch-changing action. When the hub sleeve turns faster than the propeller hub, the pitch of the blades is increased; conversely, when the rotational speed of the sleeve is less than that of the hub, a decrease in blade pitch occurs. The blade pitch remains unchanged when the hub and hub sleeve are turning at the same speed. Accordingly, the pitch of the blades may be controlled by varying the difference in speed between the hub and the sleeve.

Varying Speed Difference of Hub and Sleeve

Variation of this speed difference is controlled by means of a speed sensitive flyweight governor attached to the governor unit variable pulley in such a manner that the position of the flyweights determines the space between the pulley flanges. As is evident from Fig. 1, an outward movement of the flyweights brings the flanges of the governor unit variable pulley closer together, resulting in an increase in the belt pitch diameter. At the same time the flanges of the pulley on the hub sleeve are separated against the hub spring force, since the belt length remains essentially constant, thereby causing a decrease in the belt pitch diameter of the hub pulley. The resultant effect of an outward movement of the flyweights, therefore, is that the ratio of the variable drive becomes greater than that of the fixed drive, thus causing the hub sleeve to turn faster than the hub. The blade pitch then increases. Conversely, an inward movement of the flyweights causes the hub sleeve to turn slower than the hub and a decrease in blade pitch occurs. When the flyweights are in a neutral position such that the ratio of the fixed and variable drives are the same, the hub and the sleeve turn at the same speed and there is no pitch changing.

As is evident from a study of Fig. 1, the flyweight force is opposed directly by the adjustable governor unit spring and indirectly by the hub springs acting through the variable ratio V-belt drive. The hub springs serve primarily to maintain the required belt tension regardless of the position of the flyweights. The control speed of the propeller is that speed at which the centrifugal force of the flyweights balances the total opposing spring force when the flyweights are in the neutral position. Adjustment of the governor unit spring through a suitable linkage to the cockpit enables the pilot to select any desired control speed over a wide range.

Function of the Flyweights

During normal operation in flight, the speed sensitive flyweights act to maintain the selected constant speed. When the propeller is on-speed, the flyweights are in the neutral position and there is no pitch changing. If the propeller should overspeed, the flyweights move outward, because of increased centrifugal force, causing an increase in blade pitch, as previously explained, thereby retarding the propeller back to the on-speed condition. Conversely, in the case of an underspeed, the flyweights move inward, causing a decrease in blade pitch, which allows the propeller to accelerate back to on-speed.

Accordingly, the propeller speed promptly returns to the selected r.p.m., within close limits, after any disturbance.

It is significant that the flyweights function merely to regulate the pitch changing action of the variable ratio V-belt drive and do not cause pitch changing directly. Hence, only a small unbalanced flyweight force resulting from a slight off-speed condition is sufficient to vary the pulley ratio and cause a corrective pitch changing action.

Moreover, with this arrangement the flyweights are substantially relieved from the effects of variations in blade loads and therefore respond freely to relatively small, as well as to large, changes in speed quite independently of the thrust or torque load on the propeller.

As a result the pitch-changing mechanism is responsive and consistent in its action and will maintain the selected constant speed within close limits under widely varying conditions of operation.

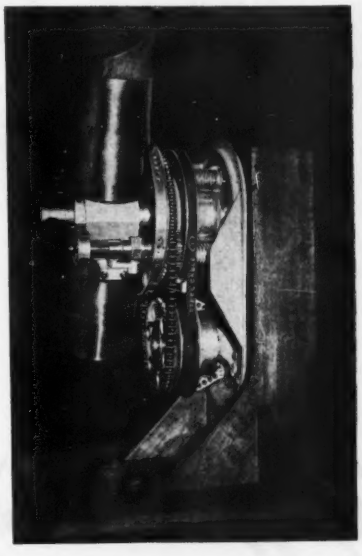
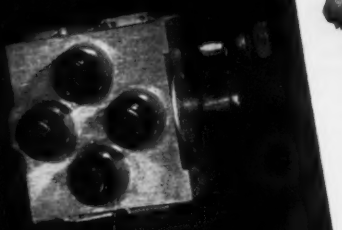


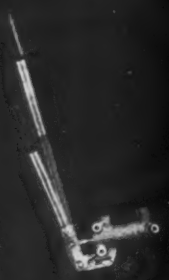
FIG. 2. Demonstration model of a 250-hp. "Iso-Rev" constant-speed propeller with spinner and cowling removed. This model utilizes a chain for the fixed-ratio drive.

DEPENDABILITY

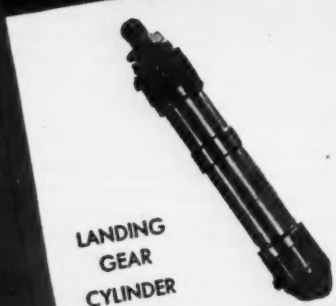


SELECTOR VALVE

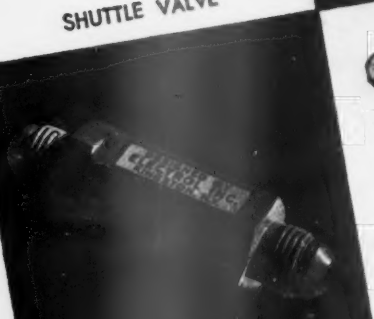
SHUTTLE VALVE



HAND PUMP

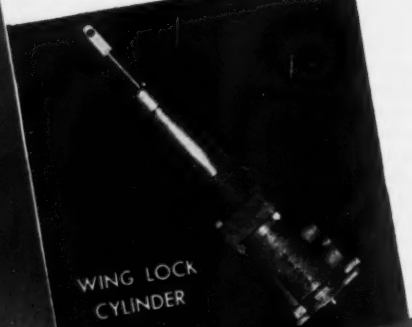


LANDING GEAR CYLINDER



CHECK VALVE

UNLOADER VALVE



WING LOCK CYLINDER

MAIN PRESSURE RELIEF VALVE

TAIL WHEEL CYLINDER

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The Pitch Limit Stop

A pitch limit stop is provided to override the action of the governor and stop pitch changing when either end of the pitch travel is approached. Otherwise belt slippage and a resultant belt damage would occur. The limit stop mechanism consists mainly of a large diameter nut threaded on the hub under the hub sleeve. Knobs on the nut pass through slots in the sleeve causing the nut to turn with the sleeve and, hence, to travel fore and aft on the hub whenever the hub sleeve is turning either faster or slower than the hub. The nut, therefore, moves whenever the pitch is changing and, in reality, simulates the fore and aft motion of the lead screws that actuate the pitch-change linkage attached to the blades. When the nut is moving forward, the blade pitch is increasing and the variable hub pulley flanges are widely separated. As the nut approaches the forward end of its travel, knobs on the nut engage lugs on the movable flange of the variable hub pulley, thereby closing the pulley flanges until the ratio of the fixed and variable drives are equalized, in which case pitch changing is stopped and the nut ceases its travel. Conversely, when the nut is moving rearward, the blade pitch is decreasing and the variable hub pulley flanges are close together. In this case the nut acts to separate the flanges as it approaches the end of its travel, thereby equalizing the ratio of the fixed and variable drives. In either case pitch changing is stopped without belt slippage.

Control Characteristics

In the design of a constant-speed propeller it is generally desirable that the rate of pitch change be as high as possible without danger of hunting. A high rate of pitch change assures a quick response to any disturbance in speed and a rapid return toward the on-speed condition. If the rate of return is high, however, excessive overshooting with a resultant instability or hunting may occur unless proper damping is provided.

Effective damping may be accomplished by progressively reducing the rate of pitch change as the on-speed condition is approached, special mechanism being provided for this purpose in some conventional propeller designs. With adequate damping the maximum rate of pitch change may be increased materially over that which would otherwise be permissible. Maximum rates of the order of 2° to 8° per sec., depending largely on the effectiveness of the damping employed, are used in conventional propeller practice. Hunting may occur occasionally if operating conditions are unfavorable and adjustments are not correctly made, but in general the performance is satisfactory.

The utilization of the variable ratio V-belt principle provides a high degree of inherent damping. The rate of pitch change varies as a function of the difference in ratio between the fixed and variable drives. As the on-speed condition is approached, following any given disturbance, the flyweights approach the neutral position, thereby causing a reduction in the difference in ratio between the fixed and variable drives and a decrease in the rate of pitch change—a highly desirable natural damping action. Actual tests have indicated even greater natural damping than might be expected from theory, as is evidenced by a marked freedom from hunting even when exceptionally high maximum rates of pitch change are used. Calculated maximum rates substantially in excess of the usual limits in conventional practice have been used successfully without hunting. In fact, the only case in which hunting has occurred during tests has been when special efforts were made to induce hunting. Even then the condition was easily remedied. Utilization of the variable ratio V-belt principle in the design has made possible a high maximum rate of pitch change without danger of hunting, thereby assuring a rapid response to disturbances in speed and a quick return to the on-speed condition.

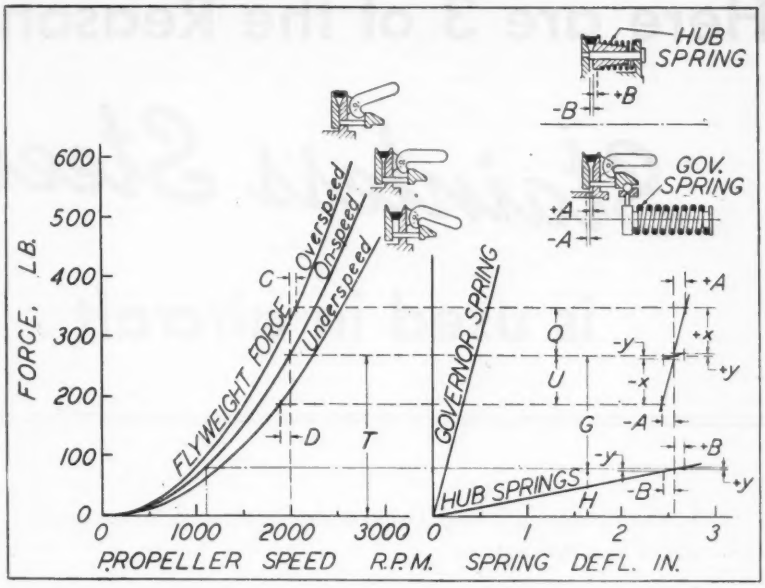


Fig. 3.

Governing Characteristics of the Control Mechanism

The governing characteristics of the control mechanism can best be appreciated from a graphic study of the interrelationship of flyweight and spring forces. Fig. 3 shows curves representing flyweight force as a function of propeller r.p.m. and spring force as a function of spring deflection, together with simple schematic illustrations showing various flyweight and spring positions. The conditions of on-speed, overspeed, and underspeed are represented, full flyweight deflection being assumed for each of the latter two conditions. It is assumed that the governor is set for a control speed of 2,000 r.p.m. The accompanying graph shows the effect of disturbances causing a departure from the normal on-speed condition.

When the propeller is on-speed, the total flyweight force is represented by T of Fig. 3. This force equals the total opposing spring force which consists of two parts: the force H of the hub springs and the adjustable force G of the governor spring. If the propeller overspeeds by an amount sufficient to cause a full outward movement of the flyweights, the flyweight force increases to some value represented by the overspeed curve. The flanges of the governor unit variable pulley are thereby drawn together by an amount indicated as $+A$, while the flanges of the variable pulley on the hub sleeve are separated by an amount $+B$ from the on-speed position. As is shown graphically, the effect of the deflection $+B$ is to increase the hub spring force by the amount $+y$, while an increase in the governor spring force by the amount $+x$ results from the deflection $+A$. Accordingly, there develops a total increase in spring force of the amount Q, which is the sum of $+x$ and $+y$, thus producing a final overall spring force of $T + Q$ represented by the upper dashed horizontal line. The intersection of this line with the overspeed flyweight force curve occurs at a point a distance C to the right of the original 2,000 r.p.m. line, which distance indicates the amount of overspeeding required to cause a full outward movement of the flyweights.

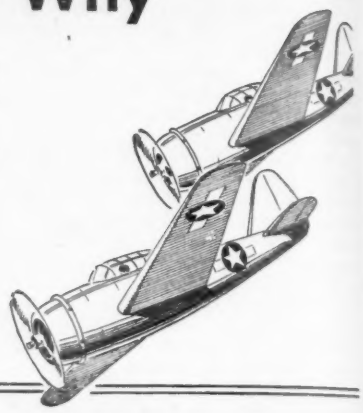
Over- and Underspeeding

Similarly, the condition of an underspeed sufficient to cause a full inward deflection of the flyweights is also shown in Fig. 3. In this case the flyweight force decreases to some value represented by the underspeed curve. The

Here are 3 of the Reasons Why

Stainless Steel

is used in aircraft



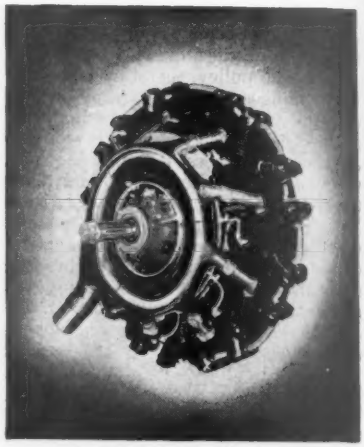
1. The high strength-weight ratio of stainless steel helps cut dead weight to a minimum.

2. Even at extremely low temperatures, stainless steel retains shock resistance, strength, and toughness.

3. Stainless steel is strong and corrosion-resistant even where high temperatures are encountered.

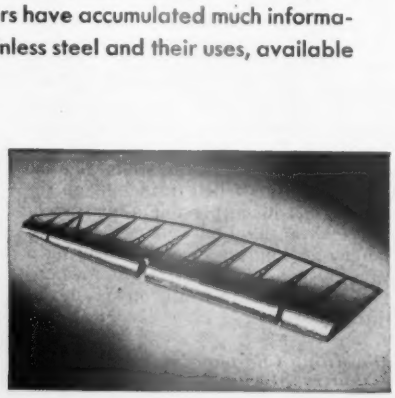
These properties—plus high fatigue strength, low maintenance, and ease of fabrication—make stainless steel valuable for structural parts, for accessories, and in engines. The booklet, "Stainless Steel in Aircraft," gives more detailed information. Write for a copy.

Although we do not make steel of any kind, we do produce the ferrochromium that makes steel stainless. In many years of experience, our metallurgical engineers have accumulated much information on the various types of stainless steel and their uses, available to you upon request.



Because stainless steel containing columbium retains resistance to heat and corrosion, exhaust systems of relatively thin-gage metal give long service.

Stainless steel helps make cargo planes lighter, safer, and stronger, and prolongs their usefulness.



Lightweight ailerons and other sections that are strong, durable, and safe can be fabricated from stainless steel.

The extra strength, plus the corrosion resistance of stainless steel, makes end sections of fuel tanks dependable.

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flanges of the governor unit, variable pulley are then separated by an amount $-A$ from the on-speed position, while those of the hub pulley are brought together, due to the force of the hub springs, by an amount $-B$. The resulting total decrease in spring force, U, which is the sum of $-x$ and $-y$, produces a final spring force of $T - U$ represented by the lower dashed horizontal line. This line intersects the underspeed flyweight force curve at a distance D to the left of the 2,000 r.p.m. line. The scale value of D represents the amount of underspeeding necessary to produce a full inward deflection of the flyweights.

It is apparent from a study of Fig. 3 that the magnitude of the overspeeding or underspeeding required to produce full outward or inward flyweight deflection can be varied by changing either the flyweight or spring characteristics or both. It is possible to obtain any desired values of C and D by a proper matching of spring and flyweight characteristics. Theoretically, zero values of either C or D represent neutral stability, while negative values should produce instability or hunting. Actually, however, tests have indicated a remarkable inherent stability, and it has been found possible to induce hunting only by intentionally providing appreciable negative theoretical values of C and D. If the spring and flyweight characteristics are properly matched for a given engine installation, consistently good response to off-speeds without any tendency toward instability or hunting will result.

The relative values of C and D of Fig. 3 may be varied by changing the on-speed position of the flyweights through proper adjustments of the mechanism. If the maximum rate of pitch changing is kept approximately the same for both overspeed and underspeed, C will be somewhat less than D, as is shown in Fig. 2. This means that less off-speed will be required to cause a full flyweight deflection for the overspeed than for the underspeed condition; hence, the response will be slightly more rapid in overspeed, which is considered desirable in practical operation because it insures against damage to the engine due to excessive momentary overspeeding. Actual tests have indicated that moderate variations in the relative values of C and D do not adversely affect the performance of the propeller; hence, the adjustments affecting the on-speed position of the fly weights are not highly critical.

Hub Spring Design

The important considerations with regard to the springs are their capacity and load-deflection characteristics. Inasmuch as the hub springs serve essentially to maintain belt tension, it is desirable that they supply just the force required for proper belt operation. The minimum control speed of the propeller is determined by the intersection of the normal hub spring force line with the on-speed flyweight force curve, which, in the diagram of Fig. 3, occurs at a propeller speed of about 1,100 r.p.m. The slope of the load-deflection curve, representing the combined effect of all of the hub springs, as shown in Fig. 3, should be as low as possible, since the belt tension preferably should be maintained as nearly constant as possible during operation. In other words, the hub springs should be as soft as practicable. The governor spring, on the other hand, for a deflection of $+A$, must increase its force by an amount $+x$, which should be just sufficient to assure adequately against instability or hunting, thereby providing quickly responsive governing action. In practical design it is generally found that the required value of $+x$ is several times greater than $+y$; hence, the slope of the load-deflection curve of the governor spring must be materially greater than that of the hub springs. The required capacity of the governor spring is determined by the value of $G + Q$ for the maximum speed at which the propeller is required to control and is, in general, substantially greater than the total capacity of the governor springs. The relative slopes of the load-deflection curves, indicated in Fig. 3, for the governor and hub springs are representative of values that have been found satisfactory in practical design.

General Considerations

The present production design of the propeller, which is a refined version of the first experimental full-scale model, adequately satisfies all of the important original design objectives. The desired constant speed may be selected by the pilot during flight by means of a simple push-pull lever. As is apparent from Figs. 1 and 2, the hub and control mechanism can be faired into a neat spinner and cowling assembly having clean lines, notwithstanding the offset position of the governor unit. Inasmuch as the energy of the rotating propeller shaft is utilized to effect pitch changing, it, fortunately, is not necessary to have available an electrical, hydraulic, or other auxiliary power source of sufficient capacity to operate the pitch-control mechanism. In basic design, therefore, the propeller is highly flexible and can be readily adapted for use on any type of aircraft engine. Incorporation of the variable ratio V-belt principle makes possible a simple, reliable control mechanism having a relatively few number of parts, all of which can be machined to moderate or liberal tolerances from readily available materials, thereby satisfying the basic requirements of low production cost. The result is an inexpensive, reliable, selective constant-speed propeller readily adaptable for use on any type of airplane engine and particularly suited to the requirements of low and moderate horsepower installations.

The incorporation of a V-belt drive in the pitch-control mechanism is an outstanding and unique feature of the propeller. Inasmuch as the basic control principle depends upon the use of a drive having a continuously variable ratio, a V-belt drive is employed not only because of the ease with which its drive ratio may be varied but also because of its simplicity, high torque capacity, and time-tested reliability. Extensive tests of the actual propeller under severe conditions of operation have substantiated the practicability of the variable ratio V-belt drive with regard to both its capacity to handle the pitch changing loads and its reliability. In no case have V-belts shown any appreciable wear even after relatively long periods of usage. The V-belt drive, as used, not only is simple to construct and adequate for the purpose but also offers the long life and reliability demanded of a rugged propeller intended for hard usage with only occasional inspection.

With regard to the possibility of belt breakage during operation, it is considered that such a mishap is an extremely remote possibility provided the belts are inspected at each normal period of engine overhaul. It is well known that V-belts, as used in similar commercial applications, generally operate many thousands of hours before requiring replacement and that they invariably show unmistakable signs of wear and deterioration long before actual breakage is likely to occur. Moreover, the use of the newly developed steel cable V-belts is recommended as a further precaution against breakage. If all parts of the modern airplane possessed the reliability of a good quality V-belt, flying would be substantially safer than it is today.

Experimental Full-Scale Tests

Most of the tests of the original experimental full-scale propeller were performed outdoors during mid-winter generally at below freezing temperatures. Often runs were made during snow, sleet, or rain, but in no case was any protective cowling or spinner used to enclose the control mechanism. Nevertheless, no appreciably adverse effect on performance of the control mechanism due to these rather severe weather conditions could definitely be detected. Accordingly, a special test was conducted in which a substantial stream of water was pumped directly on the rotating belts during operation. It was observed that even in this extraordinarily severe circumstance the control mechanism continued to function and maintain the constant speed reasonably well, although the response to off-speeds was noticeably slower. Within 2 min. after the flow of water was stopped, however, the performance of the control mechanism had returned to normal. Tests were also made in which the V-belts were subjected to abnormal quantities of grease and oil, but the effects on the performance, in this case also, were not seriously adverse. All observations made to date, therefore, indicate that the variable ratio V-belt mechanism will function even under the most severe conditions.

(*Continued on page 55*)

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New Wrought Aluminum Alloys for Aircraft and New Temper Modifications of Present Alloys*

DON A. LAWLESS†
Reynolds Metals Company

Introduction

Aircraft designers have always been interested in aluminum alloys for structural members which would provide greater strength for equivalent weight, but until a short time ago 24ST was nearly always specified for such applications. Although this was partly from habit, it must be admitted that the designers had little choice in the matter. The picture is rapidly changing, however, and today the designer has (or soon will have) at least two new structural alloys and several temper modifications of existing alloys for his applications. It is likely that he will also have one of the standard strong alloys available in bar and rod form as a free machining alloy.

This paper is mainly a review of certain of the developments to date, since the situation is such that more than relatively brief mention of these developments would be out of order in most instances. Its main purpose is not necessarily to predict which of the new developments will eventually prove the most satisfactory for general use; nor is it intended that all of the information presented will be new. However, as these developments have not, to the best of the author's knowledge, been considered previously as a group, this paper may be helpful to aircraft engineers for reference purposes in planning their own investigations.

Temper Modifications

As a preliminary part of the discussion of temper modifications, it seems desirable to mention recent changes to Government specifications. Until recently, all Government specifications for 24ST aluminum-alloy sheet showed physical properties that could be obtained either by heat-treating from the "O" condition in the aircraft manufacturer's plant or by heat-treating "as-rolled" material in the aluminum producer's plant, without any particular attention being paid to the intensity of leveling or other finishing operations after heat-treatment. The changes sponsored by Army and Navy aeronautical activities,[1] however, take advantage of the fact that mill flattening operations (roller leveling, skin pass rolling, and stretcher leveling) on 24ST sheets naturally impart a certain amount of strain hardening in addition to the heat-treated hardness.

In other words, as all sheets receive a limited amount of "RT-ing" when produced to standard specifications, the Government decided to take advantage of these increases by raising the tensile and yield strength requirements for all 24ST sheet by amounts ranging from 2,000 to 6,000 lbs. per sq.in. over the values required for material heat-treated from the "O" condition.

(Although nearly all aircraft manufacturers now order to the new Army-Navy specifications, many still seem to insist on the same formability as obtained on the material produced to the older specifications. This places increased responsibility on the aluminum producer.)

Increasing the Strength of 24S

Probably the most important work to date on increasing the strength of 24S has been that of Mozley.[2] Although the idea of increasing the strength of aluminum alloy by artificial aging is not new, his investigations have done much to show the actual possibilities of this treatment, since he gave careful attention to the practical aspects of this matter. Several ways of obtaining improvement were reported, but his conclusions (and private advices) indicate that the optimum properties may be obtained by stretching the material to approximately 1 per cent permanent set and aging 16 hours at 350°F. or 10 hours at 375°F. The major portion of Mozley's work was on Clad 24S sheet, and he reports tensile and yield strength values of about 68,000 and 62,000 lbs. per sq.in. for sheets that have received this treatment. However, future specifications involving this temper will specify minimum tensile strengths in the neighborhood of 65,000 lbs. per sq.in. and yield strengths of about 57,000 lbs. per sq.in. after aging to allow for certain variations in the un-aged sheet commercially available. It is likely that artificially aged 24SRT will also be used for aircraft applications, and the minimum values for this temper will average about 69,000 tensile and 65,000 yield.

"UT" Temper

Another important temper modification for 24S sheet is what might be termed a "reverse" modification and is designated as "UT" temper. The establishment of this temper was mainly at the request of aircraft manufacturers using the stretcher method of forming sheet in the "T" condition. Considerable tearing occurred with sheet produced in the regular manner—i.e., with sufficient rolling and stretching after heat-treatment to produce commercially flat material (and to meet the newer specification values). It was found that sheets that had been hardened by heat-treatment alone were much more satisfactory in this respect than the standard flat sheet. While the amount of material purchased in this condition has not been large as compared with the quantities of standard sheet produced, nevertheless, the quantities have run into several hundred thousand pounds, and it is considered rather significant that this demand should come at a time when the major efforts are in the other direction.

Material in the "UT" temper will meet the physical property requirements of Federal specifications which, as mentioned above, have slightly lower tensile and yield requirements than the currently used ANA specifications. Sheet in the "UT" temper is frequently not so flat as standard sheet, but this apparently is of no particular disadvantage for stretcher forming operations.

Presented at the Materials Session, Twelfth Annual Meeting, I.A.S., New York, January 25–27, 1944.

* The author wishes to express his appreciation of the cooperation of Mr. P. P. Zeigler, Chief Metallurgist, Reynolds Metals Company, in supplying much of the information reviewed in this paper.

† Material Engineer.

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TABLE 1

	Tensile Strength (Lbs. per Sq.In.)	Yield Strength (Lbs. per Sq. In.)	Elongation (% in 2 In.)
R301-O	30,000 (max.)	....	16.0 (min.)
R301-W	57,000 (min.)	37,000 (min.)	16.0 (min.)
R301-T	65,000 (min.)	57,000 (min.)	8.0 (min.)

NEW ALLOYS

Modified Dural Type

A recent new development known as R301 aluminum alloy, in sheet form, is receiving considerable attention by aircraft manufacturers because of its high yield strength and other desirable properties, such as good formability. Although this material differs from other aluminum-alloy sheet in that it is supplied only in cladded form and that the cladding responds to the same heat-treatment as the core, it is, nevertheless, believed properly termed a Dural type, since the core is of this general composition.

The highest strength of this alloy is developed by a heat-treatment that includes artificial aging, and, on the basis of test results to date, the physical properties that this alloy can be expected to develop are shown in Table 1. On comparison with the current ANA specification values for Clad 24ST, it will be seen that an approximate increase of 10 per cent in tensile strength and 45 per cent in yield strength is shown by this alloy in the quenched and aged ("T") condition.

The formability of this material in the annealed condition appears equal to, or better than, 24SO, and in the "W" condition it will form somewhat better than 24ST. Available information on the forming characteristics of R-301 in the "T" condition, as compared with 24ST, indicates that these are about equal.

The corrosion resistance of R301-T is superior to that of Bare 24ST sheet but does not seem to be quite so good as that of Clad 24ST sheet. Tests have indicated that R301-T is not subject to accelerated corrosion when stressed.

The spot-welding characteristics of R301-T sheet are rather interesting. On examination of cross sections of spot welds of Clad 24ST sheet, it is often noted that there is a slight protrusion of the cladding into the fused zone, but this protrusion does not seem to occur when sheets of R301 are spot-welded. This characteristic seems conducive to increased fatigue strength and possibly other desirable qualities.

Annealing procedures for this alloy are similar to those used for 24S. The quenching temperature is 930° to 950°F. and the aging treatment recommended is 18 hours at 320°F. if forming operations are involved after quenching. Five hours at 360° is satisfactory if no forming is involved.

Zinc-Magnesium Type (Rewritten October, 1944)

For applications requiring highest strength, considerable interest is being shown in aluminum alloys of the zinc-magnesium type. Aluminum alloys containing appreciable amounts of zinc (5 to 10 per cent) are not new, but, because the control of other elements present has been found to be of the greatest importance, it is necessary that the exact analysis of the successful alloys be withheld for the time being.

75S, 76S, and R303 are alloys of the zinc-magnesium type which are now being produced in commercial quantities, although these alloys vary somewhat in composition. All develop maximum strength and corrosion resistance by means of artificial aging treatments after heat-treatment, but this type of material is usually not supplied in the "W" temper because of the length of time involved to reach stable properties at room temperature. Alloys of the zinc-magnesium type may be supplied in the form of Bare and Clad Sheet, Extrusions, Bars and Rods, and Forgings.

The guaranteed properties of heat-treated and aged alloys of the zinc-magnesium type are of the same general order for material of equivalent form, as indicated in Table 2. (The values given in Table 2 for 75S are from Army-Navy Aeronautical specifications, and the values for R303 are from manufacturers' literature.)

A maximum tensile strength of 35,000 to 40,000 is usually specified for material in the annealed condition.

In the case of Bare R303-T (and undoubtedly in the case of Bare 75ST also), the resistance to both pitting and intergranular types of corrosion has been found to be superior to that of Bare 24ST on the basis of comprehensive tests involving stressed and unstressed samples. These findings are in the face of the fact that, in previous years, aluminum alloys containing substantial quantities of zinc were considered to have rather poor resistance to certain types of corrosion. Tests of clad sheet samples of R303-T show corrosion resistance equal to or better than that of Clad 24ST. However, the superiority of Clad R303-T over the unclad material is not as great as in the case of Bare and Clad 24ST, because of the inherently better corrosion resistance of the zinc-magnesium type base metal.

Government specifications for 75S indicate that the quenching temperature is 860° to 930°F. and that the aging treatment consists of heating at 250°F. for 24 hours. The quenching temperature for R303 is 810° to 840°F., and the lowest aging temperature recommended is 275°F. (for 25 hours). Where a shorter aging period is desired, R303 may be aged at 315°F. for 8 hours. The latter treatment results in slightly better formability and corrosion resistance but decreases the tensile and yield strength somewhat from that developed under the 275°F. treatment.

The formability of aluminum alloys of the zinc-magnesium type does not differ greatly from that of 24S. Tests indicate that both alloys in the annealed condition are about equal in formability and that R303-T315 in the heat-treated and aged condition requires only slightly larger radii than 24ST. As in the case of 24S, the zinc-magnesium alloys may be readily formed immediately after quenching.

Free Machining Type

While the matter of machinability of aluminum alloys may be of only secondary interest to aircraft engineers, it is believed desirable to mention a new development in this connection also. Heretofore, the strong alloys of standard analyses, such as 17S and 24S, have not been everything that could be desired with regard to machinability. In cases where machinability has been the main consideration, it has been customary to specify an entirely different alloy. However, results of experiments on fair-sized production quantities of bars and rods indicate that it is entirely feasible to introduce additional elements, such as lead and bismuth, into the standard 17S composition and thus combine the optimum qualities of two different alloys. There appears to be no reduction of strength or corrosion resistance because of such additions, but the machining qualities are improved considerably. This modified alloy can be forged also, which should be of interest to manufacturers of aircraft plumbing fittings, etc.

TABLE 3

Type	Tensile Strength (Lbs. per Sq.In.)	Yield Strength (Lbs. per Sq.In.)
Artificially Aged 24ST (Clad) (Previously Strain Hardened)	65,000	57,000
Artificially Aged 24SRT (Clad)	69,000	65,000
Modified Dural (R301)	65,000	57,000
Zinc-Magnesium Type (Clad Sheet)	70,000	64,000

TABLE 2

	Tensile Strength, Lbs. per Sq.In. (Min.)	Yield Strength, Lbs. per Sq.In. (Min.)	Elongation, % in 2 In. (Min.)
75ST Clad Sheet	72,000	62,000	8
75ST Extrusions	78,000	70,000	6
R303-T275 Clad Sheet	70,000	64,000	7
R303-T275 Extrusions	75,000	70,000	7

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New straight-line production methods that eliminate all costly back-tracking . . . reject sub-standard parts quicker . . . and save vital production time make this price reduction possible. *But the quality of Thompson Bolts remains unchanged.* Additional plant area, and placing of equipment for maximum efficiency for step-by-step production from one operation to the next—with close inspection at every station—effect the substantial production savings that are passed along to you.

You can take immediate advantage of this price reduction on your present needs for Thompson Bolts in either the Internal Wrenching Head N.A.S. types . . . or the special Thompson Bolts that are engineered for specific applications. We will be glad to supply further details on the precision aircraft Bolts we are now manufacturing in quantity, and mail without obligation to authorized persons an interesting 16-page Brochure describing Thompson manufacturing methods. Address Thompson Products, Inc., WEST COAST PLANT, Bell, California.

THESE OUTSTANDING MANUFACTURING METHODS ARE INCLUDED IN ALL THOMPSON BOLTS PRODUCT

HOT FORGING—Thompson Bolts are gathered in special electrical upsetting machines and forged to shape at red heat to produce the desired grain flow in the bolt that increases strength and uniformity.

CONTROLLED HEAT TREAT—All Bolts are absolutely heat treated to produce a tensile strength ranging from 160,000 to 180,000 p.s.i.—and higher!

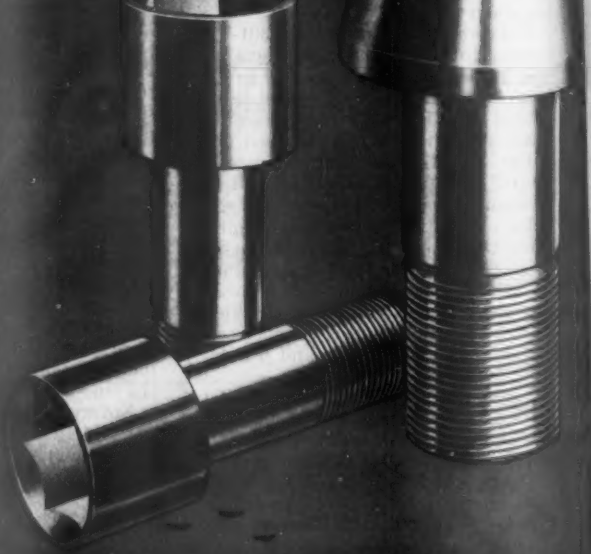
GROUND SHANK—To produce a smooth bearing surface, free of tool marks and concentration points—and to improve fatigue resistance—all bolts are ground to close tolerances.

GROUND THREADS—Thompson Bolts have ground threads—not rolled or cut—to insure a smooth, precision thread finish and to give them a perfect radius for maximum fatigue resistance.

GROUND UNDER HEAD—Bolts are ground under the radius and under the head to insure a true bearing surface and prevent stress concentration at any one point.

100% INSPECTION—Every bolt—not just five from each run—is given an exhaustive series of inspections and checks to guarantee perfection in every bolt that leaves the plant.

These—and many other important steps in manufacture—are the plus values that go into all Thompson Bolts to insure the finest products in their class. More details on Thompson methods are yours for the asking.



ARMY-E-NAVY

Thompson Products, Inc.

WEST COAST PLANT ★ BELL, CALIFORNIA

Aircraft Engineering Factors

In reviewing the new high-strength aluminum alloys and temper modifications, it does not seem unreasonable to assume that values such as given in Table 3 will be specified for aircraft structural applications in the future. In view of the obvious importance of these values, it is believed desirable to present a brief discussion as to a few of the factors that may govern the selection of the individual items for aircraft applications, although, as indicated earlier, no attempt will be made to predict definitely which of the alloys or tempers will become the most widely used, particularly in sheet form.

For applications involving the use of aluminum-alloy sheet, there is much in favor of the use of artificially aged 24S, provided the forming operations involved are not of such severity as to require the use of annealed material. (Heat-treated 24SO cannot be aged-hardened so much as material produced originally as 24ST.) All other factors being equal, the use of alloys of familiar characteristics, particularly in the "as-received" condition, is always advantageous, at least as far as production is concerned. However, where severe forming operations are involved and the use of material in other than the annealed ("O") condition is not practical, the new composition types seem to offer interesting possibilities.

In considering forged structural fittings and extruded shapes, there seems to be little doubt that there will be a decided swing to the newer alloys. 14S is gaining in popularity in these forms in spite of its somewhat inferior corrosion characteristics, and on the basis of present information it seems reasonable that increased use of the zinc-magnesium type will be a natural development. Perhaps all of the above types will be found in the same airplane in the future, but this, of course, would not be without major difficulties in connection with stocking, maintenance, etc.

In any event, it is believed that the engineer is going to have to make some rather important decisions with regard to aluminum in the near future, and it also appears that from now on it will be necessary for him to direct much more of his attention to the workability of his material in the various tempers than he did in the past. Apparently, it has been the standard practice in some aircraft organizations to indicate the ultimate temper (usually 24ST) on the drawings and to allow the production department to decide which of the tempers were to be referenced in procurement specifications. As a matter of fact, this procedure is no longer possible, even under the new ANA specifications for 24ST sheet, if full advantage is to be taken of the slightly increased strength of material purchased in the "T" condition over that developed by material purchased annealed and subsequently heat-treated.

Conclusion

This paper has reviewed only briefly the properties and application possibilities of the new alloys and tempers. It is obvious that a large number of additional investigations will have to be conducted and much balancing of conflicting factors will be necessary before the final answers are obtained. A few things appear certain, however. One is that aircraft engineers will have a much wider choice of aluminum alloys and tempers for aircraft applications in the future. Another is that the engineer himself is going to have more responsibility than in the past in the selection of the alloy and the temper in which it is purchased. The main consideration, of course, is that much stronger material is now available and that airplanes of the future will benefit greatly from the use of these new materials.

References

[1] Army-Navy Aeronautical Specifications AN-A-12 and AN-A-13 for Aluminum Alloy (Al-24 and Al-24C2) Plate, Sheet, and Strip.

[2] Mozley, Paul P., *Elevated Temperature Aging of 24S Aluminum Alloy*, Journal of the Aeronautical Sciences, Vol. 10, No. 6, pp. 180–184, June, 1943.

[3] Army-Navy Aeronautical Specifications AN-A-10 and AN-A-11 for Aluminum Alloy (Al-XB 75) Clad Sheet and Extruded Shapes.

(*Continued from page 15*)

aircraft design engineers and detailers; (c) a better understanding of the capabilities of wood in aircraft by the aircraft industry and the general public.

(4) Following the war a slower and sounder development of wood usage will take place. The properties and service data will be gathered and analyzed in a conservative manner. The particular applications for which wood may be efficiently used will be ascertained. Prejudices founded on bad practices or lack of information will disappear slowly under the weight of successful examples.

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TRADE-MARK

Ideas are Ammunition, Too

This is the largest item ever molded from BAKELITE phenolic molding board, BM-9725. It's an ammunition box for a bomber belly turret that packs looped lightning in the form of long belts of cartridges. It is 25½ in. by 17½ in. by 6½ in. in size. It is extremely lightweight, highly resistant to impact, abrasion, moisture, and chemicals, and has high tensile strength.

Until now, the plastics industry has used BAKELITE phenolic molding board chiefly for much smaller parts. The idea of employing its outstanding advantages for a large scale molding job was revolutionary, but has more than justified itself in a product that stands strenuous service, and is economically produced. Rigidity and extra strength are attained by molding the box from two sheets of BM-9725 around a sisal core that has been impregnated with phenolic resin. Both halves of the box are formed simultaneously in one cast iron mold. The press is equipped with banks of infrared lamps for preheating the mold charge and operates at a pressure of 1,000 pounds per square inch.

Ideas such as those that produced this box are ammunition for present and future planning—ammunition that hits the mark in product improvement and production economy. BAKELITE molding boards are available in sheets, blanks, and as diced material. They can be molded on existing equipment—either alone, or in combination with other BAKELITE plastics to reinforce vital points. Write Department 25 for full information and suggestions regarding molding techniques.

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Molding Plastics

AERO-ECONOMICS

JAMES B. KENDRICK*

Lockheed Aircraft Corporation

Introduction

Considering the many individual models of aircraft which have been produced, it is noted that a few of them have been outstanding, some with obvious features that were useful at the time, and others without any apparent special feature but with generally well-proportioned characteristics, high overall utility for the purpose intended, and evidence of excellent design. By what process were these desirable proportions determined? May this process be reduced to engineering practice?

The aircraft designer must select, from a wide variety of possibilities, a combination of features which will result in the best design. His selection should be based not on mere personal opinion, prejudice or conventional practice but on a careful analysis of the anticipated conditions from a broad, rational point of view. In order to facilitate this process a new engineering philosophy must be recognized, consisting of many old methods and ideas assembled under a new heading, which may be called "Aero-Economics." This is the study of economic problems involved in aircraft design and operation by means of the differentiation and evaluation of certain factors for a given set of operating conditions. Simple terms for expressing the "value of a pound" and other pertinent aerodynamic and operational quantities may be derived for convenience in analyzing problems involving many interrelated effects and in arriving at the most economical solution. The use of these principles may be of benefit in many ways to operator, designer, manufacturer, financier, and others.

The available records show that the cost of operating a large fleet of airplanes is enormous, involving sums of money many times greater than the cost of developing and producing the planes. Extensive savings may be possible in operation by more careful design and development.

Every design feature should have a definite beneficial effect upon the overall utility in order to justify itself. A rational aero-economic approach helps to show which phases of the design are most important and worthy of careful control in contrast to other less important features where control may be relaxed without hindering the utility. Furthermore, development activity will be most effective if the planning and direction thereof are aided by a true perspective of the overall problem. The methods described herein permit the selection of the most fruitful fields for development, and the logical allocation of sufficient funds and facilities to assure success in such undertakings.

Because of the fact that the airplane is an assemblage of air frame, engines, propellers, and equipment, all produced by different concerns, aero-economic analyses are needed as a coordinating influence. In order for the aircraft manufacturer to effect an improvement in some other component, he must satisfy the component manufacturer of the economic importance of the change, and the dollar-wise increase in value of the component after such improvement has been incorporated.

The operator must also be convinced of the value of an improvement and be willing to stand a fair share in the development cost involved. This provides the incentive to make improvements in the product. Failure to realize and accept this principle leads to the early obsolescence of a model in favor of some newer design of unproved characteristics and, possibly, of less overall utility to the operator. It is apparent, therefore, that the economic proof of an improvement must be thoroughly convincing to the aircraft manufacturer, the component manufacturer, and the operator in order to influence wisely the course of progress in aircraft design and operation.

The discussion hereafter is based upon the operating conditions for range and load-carrying aircraft, such as transport and cargo planes. Similar methods may be used for evaluating other conditions and types by the derivation of other simple rules. Military airplanes, although not usually considered from the same economic standpoint as commercial aircraft, may still be judged by the same rules as a measure of military utility for bombers, patrol, and cargo planes, provided other tactical aspects are also carefully considered and evaluated.

The economic analysis may be divided into several general classifications: (1) operating cost, (2) revenue or military load, (3) attractiveness to operator, including factors such as superior performance, safety and ease of operation, stability and control, and other similar items.

Operating Costs

A cost breakdown for the proposed operation is needed for judging the effectiveness of proposed economies. Such a breakdown may be based on past statistics or on estimates showing the total operating cost T for one airplane for N flying hours (the assumed life of the airplane) and the per cent distribution between various logical subdivisions. A sample breakdown of this type is as follows:

$T = total operating cost for N flying hours
Initial cost = I per cent of T
Fuel and oil = F per cent of T
Engine maintenance = E per cent of T
Airplane maintenance = A per cent of T
Flight operations
Ground operations
Passenger service
Overhead, profit, etc.

Gross Revenue, Ton-Mile Cost, and Military Load

According to the above operating cost for the service in question, the gross revenue per airplane required for balance must be

$$\$T = KWNVR/2{,}000$$

and the ton-mile rate R should be

$$\$R = (2{,}000T/KWNV) \text{ per ton-mile}$$

where KW = pay load, W = gross weight, and V = block-to-block cruising speed in miles per hour. Note that the rate R, which is based on the total operating cost over a long period, contains proper allowance for partial load operation, hours flown per day, overhead and profit, and other similar factors.

Value of a Pound

An extra pound of weight empty subtracts from the allowable pay load, and its value is therefore equivalent to the revenue produced by 1 lb. of pay load throughout the life of the airplane or

$$\$P = \$(RNV/2{,}000) \text{ per airplane}$$

which may be called P, for "pound," this factor appearing frequently in the following pages.

The design should be carefully studied to avoid excess structural, nonstructural, and equipment weight. This important process is a necessary step in the development of a model. It may be found economically desirable to redesign completely after structural, flight, and service tests have indicated where adequate savings may be accomplished to justify the cost of redesign and tooling.

A pound of fuel is equal to a pound of weight empty. Excess fuel detracts from the pay load in the same manner as excess structural weight. The fuel weight required and the various factors affecting fuel consumption and reserve are important because of the large weights involved. Measures for decreasing the fuel weight (such as improved engines and carburetors and reliable blind landing radio) and still insuring safe completion of the mission may add to fixed equipment weight but materially increase the allowable pay load.

Presented at the Aerodynamics Session, Twelfth Annual Meeting, I.A.S., New York, January 25–27, 1944.

* Chief Aerodynamics and Flight Test Engineer, Factory A.

Range Considerations

The relative values of weight empty, fuel weight, airplane drag, and propulsive efficiency depend upon their effect on the revenue producing factor, pay load

$$\text{pay load} = W - OWE - W_F - W_{FR} = KW$$

$$= W - OWE - W_{FR} - \left(\frac{SFC}{\eta}\right)\left(\frac{D}{375}\right) \times \text{range}$$

$$K = 1 - \left(\frac{OWE}{W}\right) - \left(\frac{W_{FR}}{W}\right) - \left(\frac{SFC}{\eta}\right)\left(\frac{D}{L}\right)\left(\frac{\text{range}}{375}\right)$$

where

OWE = operating weight empty = real weight empty + crew + fixed equipment
W_F = fuel weight for range
W_{FR} = reserve fuel weight
D/L = drag/lift ratio of airplane
η = propulsive efficiency
SFC = specific fuel consumption-lbs./b.h.p. hour

This simplified concept, Fig. 1, provides a useful method for testing the following: the value of a change in D, η, or SFC; the effect of compromise between operating weight empty and these factors to result in the maximum pay load for a given range; effect of changes in operation involving a new range; and the detrimental effect of excess empty weight and reserve fuel.

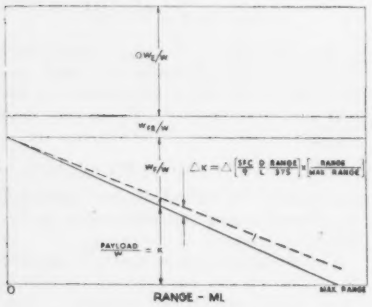

Fig. 1. Factors affecting pay load and range.

The dollar value of any increase in K reflects immediately as an increase in revenue of

$\$(\Delta KWP)$ per airplane

The real effect of improvement in D, η, and SFC, each appearing as the first power in the factor W_F, must be considered with respect to the range desired. An improvement of 1 per cent in any of these factors results in an increase in pay load, the advantage increasing with the range because of the integral effect on fuel weight. Improvement in the factor W_F is measured by

$$\Delta K = \Delta\left(\frac{SFC}{\eta}\right)\left(\frac{D}{L}\right)\left(\frac{\text{range}}{375}\right)\left(\frac{\text{range}}{\text{max. range}}\right)$$

and the dollar value of such changes may be estimated accordingly. The maximum range is that condition where the pay load is zero because of the fuel weight required.

Savings in Ground Time

Considerable savings in block-to-block time may be effected by reducing the ground handling time. This saving in time would permit the same schedule of operation at lower cruising speed and horsepower required, resulting in lower fuel weight and fuel cost and reduced service cost for engines. The cruising speed V_{cr} in m.p.h. is equal to distance/T_A or distance/$(T_B - T_G)$, where T_A = air hours, T_B = block hours, and T_G = ground hours. The brake horsepower saved by reduction in T_G is proportional to $V_{cr}^n = (\text{distance}/T_B - T_G)^n$. Differentiating, Δb.hp./b.hp. $= n \times [\Delta T_G/(T_B - T_G)]$, where n varies from 0 to 3 as the cruising speed increases above that corresponding to maximum L/D. The principal savings due to reduction in ground handling time are threefold: (1) direct fuel cost saving = \$ (Δb.hp./b.hp. $\times$ fuel cost) per airplane; (2) reduced engine service = \$ ($F \times$ engine service cost) per airplane; (3) increased pay load due to fuel saving = $\$(\Delta W_F P)$ per airplane; where $\Delta W_F/W_F = n\Delta T_G/(T_B - T_G) - \Delta T_A/T_A$.

Value of a Horsepower

This may be studied from two points of view: (a) take-off and (b) emergency climb.

(A) *Take-Off.* If a take-off distance S_{50} over a 50-ft. obstacle is to be met, the following empirical rule may be used: $S_{50} = 6(W/S)(W/\text{hp.})$; $\dot{W} = (S_{50}\text{Shp.}/6)^{1/2}$, where W/S = wing loading in lbs. per sq.ft. and $W/\text{hp.}$ = power loading in pounds per horsepower. If $\dot{W}$ is limited by S_{50} rather than structural strength, the dollar value of an extra horsepower is

$\$[\frac{1}{2}\sqrt{(S_{50}S/6\,\text{hp.})}P]$ per airplane

whereas if structural strength constitutes the limitation on $\dot{W}$, then additional structural weight must be added to permit additional pay load, and the dollar value of an extra horsepower will vary from the above factor to K times that factor, depending on the amount of structural weight required.

(B) *Emergency Climb.* If a minimum rate of climb C in f_{pm} must be preserved with engine(s) inoperative, then $C_{min.}$ = excess b.hp.$(\eta)(33{,}000/\dot{W})$ and $\dot{W}$ = excess b.hp. $(\eta)(33{,}000/C_{min})$. Assuming $C_{min.} = 300\,f_{pm}$ and $\eta = 0.75$, then $\dot{W}$ = excess b.hp.$(0.75)(33{,}000/300)$. Under these conditions one extra horsepower is worth approximately

$\$(80P)$ per airplane

Value of 1 M.P.H. Cruising Speed

Cruising speed has an important bearing upon the economy of operation and the permissible pay load. The real value of these factors may be better appreciated by the results of an investigation of a "family" of twin-engined airplanes comparable to the well-known DC-3, all equipped with the same power plant and using the same cruising horsepower.

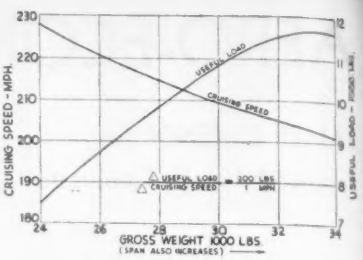
CRUISING SPEED - MPH.
USEFUL LOAD - 1000 LBS.
USEFUL LOAD
CRUISING SPEED
△ USEFUL LOAD = 200 LBS.
△ CRUISING SPEED = 1 MPH.
GROSS WEIGHT 1000 LBS.
(SPAN ALSO INCREASES)

Fig. 2. Effect of cruising speed on pay load for a family of twin-engined airplanes.

The *airplane size was progressively increased* to permit increased gross weight and pay load at the expense of cruising speed. The performance of each member of the family was adequate for safe commercial operation from the standpoint of take-off distance, emergency climb, landing speed, etc. As a result of this study, an increase in pay load of 200 lbs. could be attained for each m.p.h. reduction in cruising speed (see Fig. 2). Therefore, the dollar value of 1 m.p.h. sacrificed in order to gain pay load by the above process will be

$\$(200P)$ per airplane

This factor of improvement in pay load must be balanced against the costs of additional air time, increased initial cost and maintenance because of airplane size, etc. The factor "200" will, of course, vary with the airplane size and type and, hence, should be rechecked for conditions different from the above example.

Maximum Lift

If a landing speed requirement V_L in m.p.h. is to be observed,

$$V_L = \left[\frac{391W/S}{C_{L_{max.}}}\right]^{1/2} = \left[\frac{391}{C_{L_{max.}}S}(KW + OWE + W_F + W_{FR})\right]^{1/2}$$

The pay load KW is, therefore, strongly influenced by the maximum lift coefficient $C_{L_{max.}}$ (see Fig. 3).

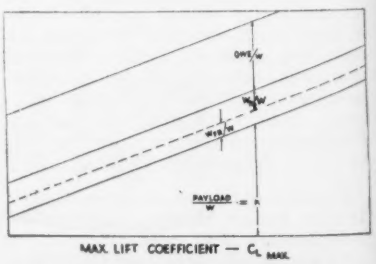

Fig. 3. Effect of $C_{L_{max.}}$ on pay load.

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NORTHROP P-61 "BLACK WIDOW"

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Many B. F. Goodrich products are now flying on all fronts with the Black Widow . . . and with other winning warplanes all over the world. Silvertown Tires, De-Icers, Bullet-Sealing Fuel Cells, and Expander Tube Brakes are helping to get our fliers off and back!

To the Black Widow now making headlines . . . and to her maker, Northrop Aircraft, Inc., B. F. Goodrich tenders a well-earned salute—our nomination of the Black Widow as "Plane of the Month."

In war or peace

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NEW DE-ICER PASSES HIGH-SPEED TEST!

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The Army wanted proof that these De-

YEAR'S SERVICE TEST PROVES SUPERIORITY OF B. F. GOODRICH TYPE ELEVEN DE-ICERS

Icers would stand up under the terrific speed strain—proof that De-Icers would be practical for fighters. A recent test gave them the answer.

One of the fastest fighters, a P-61 Black Widow, was equipped with Type 11 De-Icers. This airplane was operated at various high speeds and the De-Icers proved satisfactory on all counts. Army acceptance was granted.

Today, after many successful years on transports, airliners and bombers, B. F. Goodrich De-Icers *for fighters* are in production.

ONE of the most grueling tests a De-Icer was ever put through took place over the past year. A B-24 was equipped with Type 11 De-Icers and sent ice chasing. For over a year its crew looked for icing conditions and, when no ice was found, it was made artificially by special equipment on the airplane so that they could give the new De-Icers every chance to prove their effectiveness. They never hangared the plane during the test period . . . leaving it out in blinding sun, sand, sleet and rain . . . so that the De-Icers would age much more rapidly than normal. The airplane actually logged 380 hours during the test. *The De-Icers were in operation 150 of these hours.* Subsequent inspection at the factory showed they were still in satisfactory condition and good for many months' service.

The Type 11 De-Icer operates on the same principle as B. F. Goodrich De-Icers now in service. The greatly improved performance indicated by the tests above is the result of refinements in design and construction briefly outlined at the right. If you are interested in more complete data on this new, more efficient Type 11 De-Icer, write today to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

NEW FEATURES OF THE B. F. GOODRICH TYPE ELEVEN DE-ICER

- **Smoother Cross-Section:** Attachment edge is thinner, reinforcing strips are eliminated, tubes are recessed.
- **Improved Tear-Resistance:** The result of a new all-over surface ply of special elastic fabric.
- **Improved Tubes:** Sponge filler and reinforcement strips have been eliminated; rubber and fabric have been used more effectively.
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NO OTHER BLIND FASTENER HAS ALL THESE ADVANTAGES

They're all good reasons why B. F. Goodrich RIVNUTS deserve a place in your plans!

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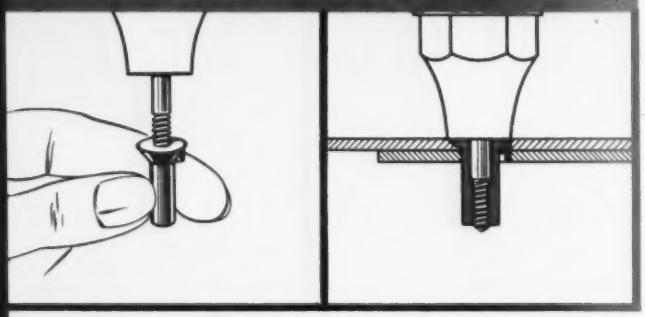
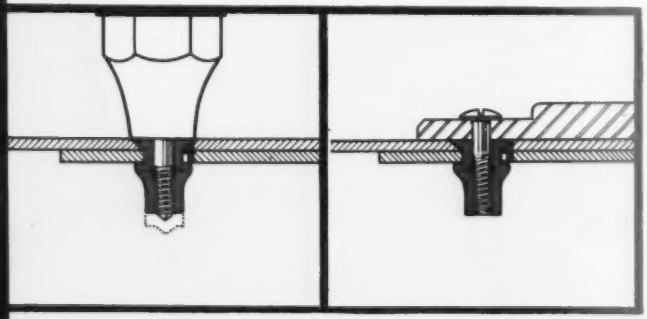
- **Simple, one-piece construction**
- **Unusually wide bearing surface**
- **Requires very small hole**
- **Forms a compression fit**
- **Quickly installed**
- **Economical**
- **Ready for use as received**
- **Wide range of types and sizes for use in wood, metal or plastics**
- **Available with key to increase torsion resistance**

RIVNUT INSTALLATION IS SO EASY EVEN A BLIND MAN CAN DO IT!



1 Rivnut is threaded on pull-up stud of heading tool until it touches the anvil.

2 Rivnut and pull-up stud are placed in holes with Rivnut head firmly against, and at right angles to, the work.



3 A squeeze on the tool lever retracts the pull-up stud slightly, causing a lateral bulge upset of the Rivnut.

4 When pull-up stud is removed, the Rivnut can be used as a nut plate. Threads grip accessory screw firmly.

ALTHOUGH DEVELOPED primarily as a nut plate for the attachment of De-Icers, Rivnuts have found many other important uses in aircraft construction. Typical fastening applications by leading manufacturers include assembling cloth-covered wings, ailerons, rudders, etc.; attaching fillets and fairing, door and window frames, access panels, insulation, light frames and the like; fastening panel board fixtures, bonding wires, clips, brackets, flooring.

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RIVNUT

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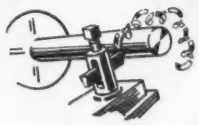
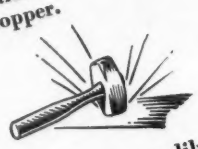
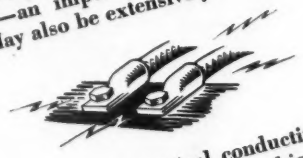
when you need all 3 –



1. MACHINABILITY—With an ease of machining close to that of free-cutting brass, this new alloy eliminates the bottleneck of producing parts from tough machining copper.



2. FORGEABILITY—Hot forges readily—tellurium has no adverse effect upon the hot working properties of copper—an important advantage over leaded copper. May also be extensively cold worked.



3. CONDUCTIVITY—High electrical conductivity (averages 90% of pure copper's). In this respect Tellurium Copper far surpasses any of the free cutting brasses. Excellent thermal conductivity, too.

IT'S A JOB FOR

CHASE TELLURIUM COPPER

Naturally, an alloy that combines all these features has found many uses in the aeronautical industry (for the manufacture of small contact pins or inserts in multiple contact assemblies)... in Electrical, Radio, Communications and similar applications, as well as in the welding and cutting torch tip field.

Full information on this unusual alloy, developed and patented by Chase Brass & Copper Co. is, of course, available on request.

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$$K = \frac{V_L^2 C_{L_{max.}}}{391 W/S} - \frac{OWE}{W} - \frac{W_F}{W} - \frac{W_{FR}}{W}$$

The dollar value of an increase of 0.10 in $C_{L_{max.}}$ is, therefore,

$\$[0.10(V_L^2 S/391)P]$ per airplane

Similar factors may be easily derived for the effect of landing speed and wing area. Effect of 1 m.p.h. increase in required landing speed is

$\$[(2V_L S C_{L_{max.}}/391)P]$ per airplane

and 1 sq.ft. increase in wing area is

$\$[(V_L^2 C_{L_{max.}}/391)P]$ per airplane

Vertical Tail Area versus Wing Area

Experience has shown that, if the vertical tail area is only large enough to provide slight directional stability, then the stalling characteristics of the airplane will be unsatisfactory and minimum speed landings at V_L will not be practical. Landings will be made at somewhat higher speeds, $V_L + \Delta V$, at which condition the airplane will feel safe to the average pilot. The amount of wing area ΔS which is wasted by inability to make minimum speed landings is equal to

$$(S - \Delta S)/S = [(V_L + \Delta V)/V_L]^2$$

$$\Delta S = S\left[1 - \left(1 + \frac{\Delta V}{V_L}\right)^2\right] \cong 2S\frac{\Delta V}{V_L}$$

The dollar value of this effect is

$$\$\left[\left(2S\frac{\Delta V}{V_L}\right)\frac{(V_L^2 C_{L_{max.}} P)}{391}\right] \text{ per airplane}$$

It may be desirable to increase the vertical tail area, perhaps at the expense of wing area, in order to effect the best compromise and the lowest (normal) landing speed. This principle also affects the gliding speed as well as the landing speed. Increased vertical tail area will permit slower, steeper glides and shorter distances to land over an obstacle. The vertical tail area should always be considered as complementary to the wing area and maximum lift in such problems, because it is really the combination that determines the landing speed and other low-speed characteristics.

Longitudinal Control and Trim

The problem of providing satisfactory longitudinal control and trim is an aerodynamic consideration involving many interrelated variables such as control forces, static stability, c.g. range, and flap characteristics. It is also an aeroeconomic consideration, for operating costs are involved in the safety and insurance rates resulting from the degree of stability, quality of pilots required, ground time required to check and adjust c.g., weight and drag involved in providing stability and trim, good will and confidence of operators, etc. These many considerations should be evaluated and balanced for the particular operation in question.

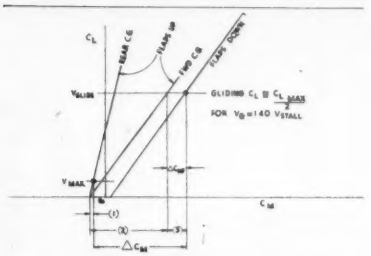

FIG. 4. Longitudinal trim range required.

The following development provides a simple means to compare the effect of the aerodynamic factors involved. Three conditions will be treated—namely, (a) longitudinal trim range, (b) stick forces for maneuvering, and (c) stick forces for landing.

There are, of course, many important factors (other than those shown below) to be considered in a quantitative evaluation of these conditions, such as slipstream effects, odd down-wash effects, nonlinearity of the derivatives, ground effect, etc. However, the following relations indicate the relative effects for qualitative studies.

Longitudinal Trim

The limits of trim range required are usually from high speed with rearward c.g. to flaps-and-gear-down-glide with forward c.g., as shown in Fig. 4, a plot of C_M vs. C_L from wind-tunnel tests. Longitudinal trim range required = $\Delta C_M = -(1) + (2) + (3) \cong (2) + (3)$.

$$\Delta C_M \cong (C_{M_{LR}} + \Delta\text{c.g.})\frac{C_{L_{max.}}}{2} + \Delta C_{M_F}$$

where

$C_{M_{LR}} \doteq dC_M/dC_L$, the static stability with rearward c.g., flaps up

Δc.g. = c.g. range desired in per cent M.A.C./100

ΔC_{M_F} = change in pitching moment coefficient due to flaps and gear

$C_{L_G} \cong C_{L_{max./2}}$, since the gliding speed is normally 140 per cent of the stalling speed

The effects of static stability, c.g. range, and high lift flaps are clearly shown. These factors should be balanced against the proposed method of trim and the operational factors involved.

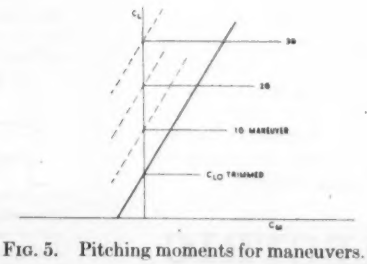

FIG. 5. Pitching moments for maneuvers.

Elevator Stick Forces for Maneuvering

If the airplane is trimmed at C_{L_0}, it requires successive increments of C_{L_0} to produce pitching accelerations of $1g$, $2g$, ng, etc. (see Fig. 5). The elevator stick forces required to produce these accelerations will then be

elevator stick force = (elevator hinge moment) F/HM

$$= (C_h q S_e C_e) F/HM$$

$$C_h = C_{h_\alpha}\alpha' + C_{h_\delta}\delta$$

C_h for ng, $C_h =$

$$\left[\frac{C_{h_\alpha}}{C_{L_\alpha}}\left(1 - \frac{d\epsilon}{d\alpha}\right) + \frac{C_{h_\delta}}{C_{m_\delta}}(C_{M_{LR}} + \Delta\text{c.g.})\right] \times nC_L$$

elevator stick force =

$$\left[\frac{C_{h_\alpha}}{C_{L_\alpha}}\left(1 - \frac{d\epsilon}{d\alpha}\right) + \frac{C_{h_\delta}}{C_{m_\delta}}(C_{M_{LR}} + \Delta\text{c.g.})\right] \times (nW/S)S_e C_e \frac{F}{HM}$$

for ng maneuvers where

F/HM = stick force/hinge moment or mechanical advantage of control system

C_h = elevator hinge moment coefficient

q = dynamic pressure at maneuvering speed = $(W/S)/C_{L_0}$

S_e, C_e = elevator area and chord, respectively

α' = local angle of attack at tail = $(d\alpha/dC_L)_{wing}[1 - (d\epsilon/d\alpha)C_L]$

δ = elevator deflection angle from trim position

$C_{h_\alpha} = \frac{dC_h}{d\alpha}$, $C_{h_\delta} = \frac{dC_h}{d\delta}$, $C_{M_\delta} = \frac{dC_M}{d\delta}$ and $C_{L_\alpha} = \frac{dC_L}{d\alpha}$(wing)

The above equation shows the effect of aerodynamic balance, static stability, c.g. range, mechanical advantage, etc., and provides a simple check on the maneuvering control forces.

Stick Force for Landing

If the airplane is trimmed at 140 per cent V_L (which is approximate; $C_{L_{max.}}/2$, see Fig. 4), the stick force required to stall will be

elevator stick force =

$$C_h q S_e C_e \frac{F}{HM} = (C_{h_\alpha}\alpha' + C_{h_\delta}\delta) q S_e C_e \frac{F}{HM}$$

$$= \left[\frac{C_{h_\alpha}}{C_{L_\alpha}}\left(1 - \frac{d\epsilon}{d\alpha}\right) + \frac{C_{h_\delta}}{C_{M_\delta}}(C_{M_{LR}} + \Delta\text{c.g.})\right]\frac{W/S}{2} S_e C_e \frac{F}{HM}$$

The similarity between the above equation and the maneuvering equation will be noted. If the various factors remain constant, the stick-force-per-g-for-ma-

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● Here's an inside view of the tiny, versatile G-E Switchette, enlarged to show you the double-break contact construction, which makes possible many ingenious wiring arrangements to solve tricky circuit problems. This is a standard form for controlling one normally open and one normally closed circuit. Variations of this arrangement are available to provide control of a single circuit, either normally open or normally closed. Other modifications include a form for simultaneously opening two circuits and closing one, or vice versa; also single-break forms for more sensitive operation.

BECAUSE of its unusually small size and light weight, its lightning-fast snap action, and its long life, the G-E Switchette is becoming more and more popular with designers for circuit control where space is at a premium.

Switchettes are available in ratings up to 10 amperes at 24 volts d-c (230 volts a-c). They are provided with solder-lug terminals for wiring. They meet government specifications covering corrosion and vibration resistance, and operate at altitudes up to 50,000 feet and in ambient temperatures from 200 F to −70 F.

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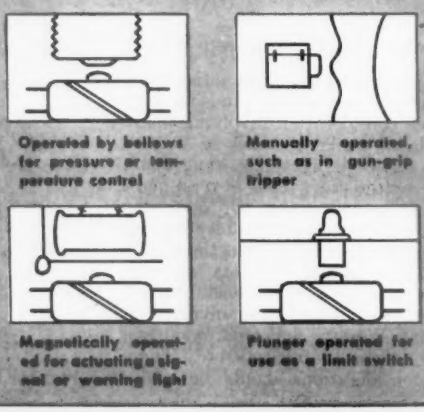
Switchettes fit right into applications like these



Operated by bellows for pressure or temperature control

Manually operated, such as in gun-grip trigger

Magnetically operated for actuating a signal or warning light

Plunger operated for use as a limit switch

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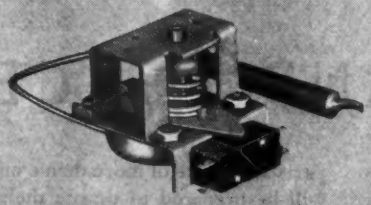
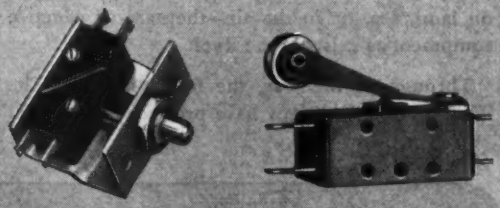
PRESSURE SWITCHES and THERMOSTATS

This sensitive air-speed pressure switch operates on a differential as small as two inches of water pressure. A Switchette is the basic contact mechanism.



Automatic control of temperature is provided by this device—a bellows-operated thermostat which actuates a Switchette.

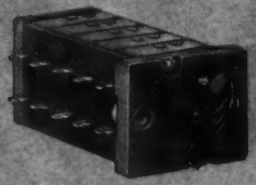
LIMIT SWITCHES



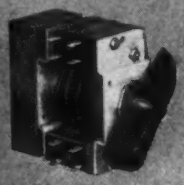
Switchettes are used as the contact mechanisms in these three limit switches. Left: Open-type switch with push-rod operation. Center: Enclosed form with extended plunger. Right: Small, roller-operated limit switch.

FOR YOUR CONVENIENCE we also *"package"* SWITCHETTES in many widely used control devices

MULTICIRCUIT and SELECTOR SWITCHES



Ten Switchettes, stacked in pairs in this compact multicircuit switch, open or close twenty circuits simultaneously.



Eight Switchettes operated by cams in this 12-position selector switch provide control of eight circuits in any desired sequence.

THE devices shown here, all adaptations of the Switchette, were developed for the electric controls that we build for all types of planes. They are ready for your use. Many others, such as push-button stations, timers, and other types of limit switches are available. For convenience and saving of time, you can use these devices in your electric control systems without modification.

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neuvering is equal to twice the stalling-stick-force or approximately equal to the landing-stick-force (due to the increased elevator deflection required to overcome ground effect).

When the above aerodynamic factors are taken into consideration and balanced against the economic factors of timesaving, weight, performance, etc., the best combination of design features may be evolved for a particular set of operating conditions.

Safety

The problem of aircraft safety may be approached from the statistical records of accidents and their causes. These records provide the basis for the probability of similar accidents occurring in the future from the same causes or combination of causes.

Total accident rate in airplane operation = A crashes in 1,000,000 hours of flying.

Crashes due to weather	= a% of A
Crashes due to radio failure	= b% of A
Crashes due to pilot judgment	= c% of A
Crashes due to collision	= d% of A
Crashes due to miscellaneous	= e% of A
Crashes due to engine failure	= f% of A
Crashes due to structural failure	= g% of A
Etc.	= .....
Total	100% of A

Probability of a crash due to weather = $aA\ 10^{-6}$ crashes/hour.

Probability of a crash due to radio failure = $bA\ 10^{-6}$ crashes/hour.

.....

Probability of a crash due to ——— cause = $mA\ 10^{-6}$ crashes/hour.

Probability of a crash due to all causes = $(a + b + \ldots .)A\ 10^{-6} = A\ 10^{-6}$

Probability of a crash from *two simultaneous unrelated causes* is $(mA\ 10^{-6}) \times (nA\ 10^{-6})$ crashes/hour, a second order effect when compared to $(mA\ 10^{-6})$ for a single cause. It is readily seen that only a slight improvement in safety is gained by designing for concurrence of unrelated events. In spite of this fact, there are numerous examples of design requirements based on the simultaneous occurrence of two *or more* unrelated events.

As an example of the above situation, suppose that a requirement for take-off-over-an-obstacle must be met which states that the gross weight should be limited by the ability of the airplane to satisfy both of the following conditions simultaneously: condition I—engine failure when take-off speed is reached; condition II—imaginary (but not real) obstacle at end of runway which the airplane must clear.

The limitation on gross weight, imposed by such requirement, causes a reduction in pay load amounting to a dollar value of $\$(\Delta KWP)$ per airplane.

The effect on insurance rates will be based upon the probability of accident if condition I or II occurs separately or if both I and II occur simultaneously. Insurance rate (condition I only) is proportional to $(mA\ 10^{-6})$. Insurance rate (I and II simultaneously) is proportional to $(mA\ 10^{-6})(1 + nA\ 10^{-6})$. The saving in insurance rates for an airplane whose gross weight is limited to satisfy conditions I and II simultaneously is extremely small, never equalling the loss sustained by reduction in pay load, because the insurance rates are based upon the *true* relative safety as determined by probability and statistics. This being the case, the customer and the operator would both prefer to take advantage of the increased pay load (and reduced rate per ton-mile) resulting from deletion of condition II as simultaneous with I.

Many other examples of such safety requirements may be cited. An aero-economic approach to such problems seems desirable to insure that the best overall solution is attained from the standpoint of customer, operator, and aircraft industry in general. Statistics may show that the time-honored philosophy of designing for concurrence of unrelated events makes such a minor difference in the *true* safety of aircraft that a sacrifice in weight empty, pay load, or operating efficiency is not justified by the small gain in safety. Great improvements in safety may be attained by attacking, first, the *individual* causes for accidents. When these primary causes have been reduced to a point where the secondary effects become worthy of attention, then the latter should be considered. Such a rational approach will lead to the greatest progress in design and operation and the greatest benefit to the users of aircraft transportation.

100 Hours Saving Between Engine Overhauls

The operating cost due to overhauling engines is $\$TE$ per airplane. An increase of 100 hours between engine overhaul periods (say from 500 to 600 hours, a 20 per cent increase) would, therefore mean savings of

$$\$(T)(E)(0.20) \text{ per airplane}$$

Other Savings in Service and Maintenance Time

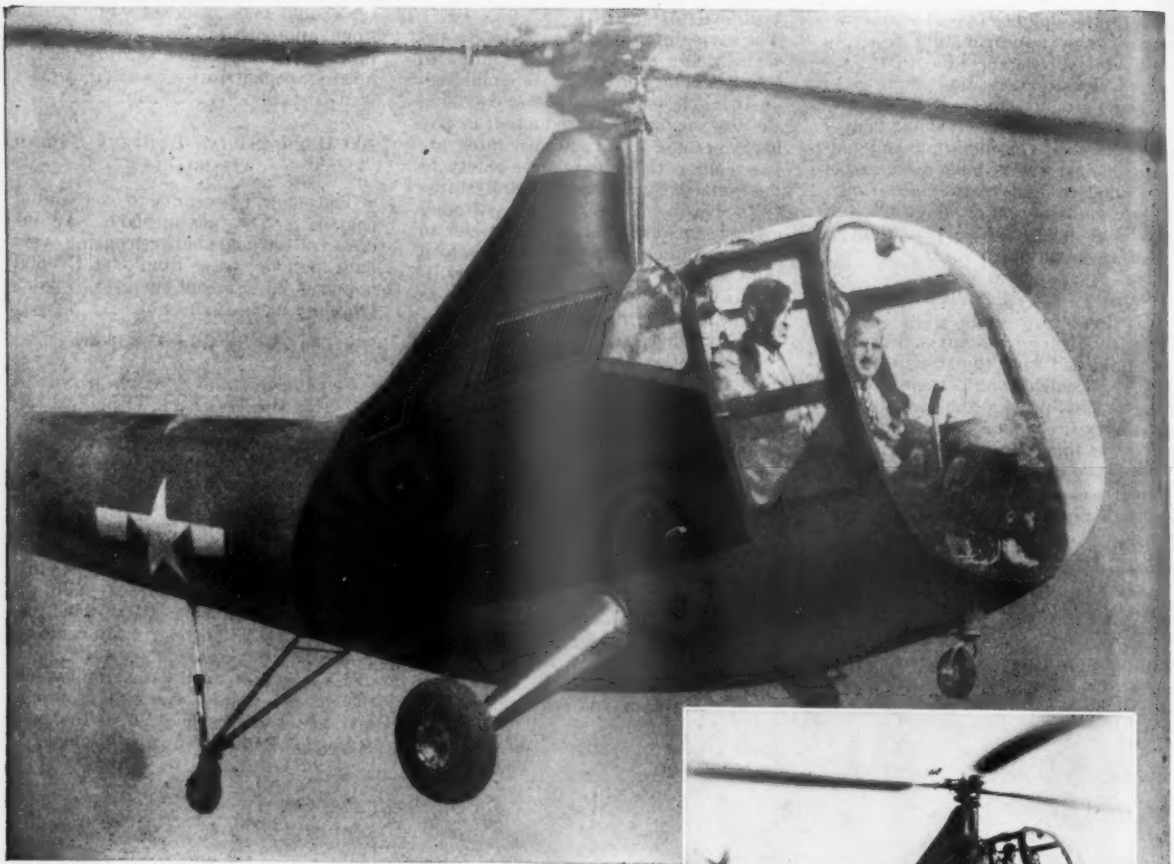
Several factors are involved in such problems: (a) accumulative cost of man-hours plus overhead, (b) revenue lost by disability of airplane = $\$(KWVR/2{,}000)$ per hour per airplane, (c) tactical loss in military operations is of great importance, (d) value of additional airplanes required to maintain schedules. Because of the specific nature of such problems, it is difficult to generalize, but an approach is usually made from statistical data, from which the factors may be evaluated approximately by a consideration of the percentage costs and probable savings.

Summary of Factors

Pound of weight empty	$P = \$(RNV/2{,}000)$	per airplane
Gallon of reserve fuel	$\$(6P)$	per airplane
Pound of drag Unit of specific fuel consumption Unit of propeller efficiency $\Delta K = \Delta(SFC/\eta)(D/L)$(range/-375)(range/max. range)	$\$(\Delta KWP)$	per airplane
Savings in ground time		
(a) Direct fuel cost saving	$\$(\Delta$b.hp./b.hp. $\times$ fuel cost)	per airplane
(b) Reduced engine service cost	$\$$(factor $\times$ eng. serv. cost)	per airplane
(c) Increased pay load Δb.hp./b.hp. $= n\Delta T_G/(T_B - T_G)$ $\Delta W_F/W_F = (\Delta$b.hp./b.hp.$) - \Delta T_A/T_A$	$\$(\Delta W_F P)$	per airplane
One extra horsepower		
(a) Take-off	$\$[{}^1/_2\sqrt{S_{50}(S/6 \text{ hp.})}P]$	per airplane
(b) Emergency climb	$\$(80P)$	per airplane
1 m.p.h. decrease in (design) cruising speed	$\$(200P)$ (see text)	per airplane
Increase in maximum lift coefficient ($\Delta C_{L_{max.}} = 0.10$)	$\$(0.10(V_L{}^2S/391)P)$	per airplane
Vertical tail area versus wing area	$\$\left[2S\left(\frac{\Delta V}{V_L}\right)\left(\frac{V_L{}^2C_{L_{max.}}P}{391}\right)\right]$	per airplane
1 m.p.h. increase in required landing speed	$\$[(2V_LSC_{L_{max.}}/391)P]$	per airplane
1 sq.ft. increase in (landing) wing area	$\$[(V_L{}^2C_{L_{max.}}/391)P]$	per airplane
Longitudinal stability and control Safety and probability Maintenance and service costs	see text	

Conclusions

It is believed that the principle of Aero-Economics, founded upon rational considerations of aircraft design and operation, should form the basis for many aircraft development activities. When used on new designs, it will lead to maximum utility. When applied to models already developed, it will indicate methods for improving the utility. When considered as a means to aid in the formulation of regulatory requirements, it may suggest the wisest regulations for the common welfare. When applied in general, it will direct the way toward greater progress for the aircraft industry.



The R-6 helicopter produced by Nash-Kelvinator of Detroit. The large picture shows Plastiply fuselage panels.

Plastiply PANELS FOR MASS PRODUCTION

A combination of distinct advantages made Plastiply the material of choice for fuselage panels on the Army's new R-6 helicopter. This phenolic laminate, produced by the Plymold process, saves weight, will not corrode, insulates, and lends itself to the automotive-assembly-line technique of mass production.

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The Correlation of Aircraft Take-Off and Landing Characteristics with Airport Size

ALAN L. MORSE*

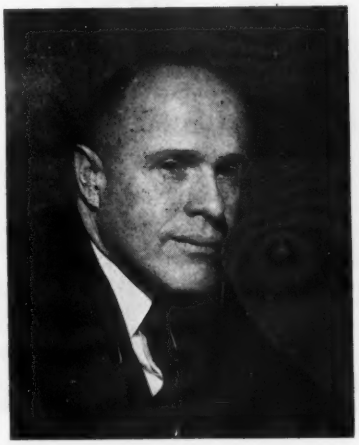
Civil Aeronautics Administration

Introduction

WE HAVE BEEN BUILDING and using airports with varying degrees of success since 1903. It seems, however, that we have never been completely happy about them. It is surprising after all these years that the apparently simple question—"How big is an airport?"—has never been answered to everyone's satisfaction in spite of the continuing program of investigations and studies of the subject.

In the "good old days" we chased the cows out of a reasonably smooth pasture or flew out of race-track ovals, and fatal accidents were more or less expected. As the novelty wore off, however, it occurred to us that flying could be made reasonably safe, and, among other things, the size of airports began to receive serious consideration. We even found it possible, in many cases, to dispense with the familiar high-tension wires. With heavier and faster airplanes came the need for paved runways of greater and greater lengths, and it was found necessary to limit the heights of structures in the surrounding areas. This has required bigger and bigger bond issues, and it has become increasingly difficult for many municipalities to locate usable airport sites. A square mile of reasonably level ground with no dangerous obstructions within two miles of its boundaries adds up to something like 20 square miles and many millions of dollars. Thus, the necessity of determining how small airports can safely be has become extremely critical. It is a most complex problem and requires for its solution a practical balancing of many factors, chief of which are operating safety, economics, and the topographic limitations in many localities. Essentially, airport dimensions need only be adequate to insure reasonable safety.

One of the numerous approaches to this problem was undertaken by the Technical Development Division of the Civil Aeronautics Administration early in 1936. Four years later the final report, "The Correlation of Aircraft Take-Off and Landing Characteristics with Airport Size," by A. L. Morse, was completed. Although the report bears the name of but one author, it represents the continuous efforts of several groups of individuals who were concerned with the various phases of the problem. Suitable means for obtaining actual performance characteristics had to be developed; the collection, sifting, and analysis of vast quantities of data were required. Since this investigation was originally undertaken to aid the Administration in connection with its airport planning and regulatory activities, the results were not published. Recently, however, and as a result of continued requests from the industry, the report has been released for general distribution. The statements and conclusions contained therein are not intended to have any regulatory significance; nor do they express the general airport policy of the Civil Aeronautics Aeronautics Administration. The report does present factual data and a suggested use of that data for correlating airport dimensions with the performance characteristics of airplanes.



The purpose of this paper is to review that report and to offer suggestions that it is hoped may prove helpful in the final attainment of a satisfactory solution to this highly controversial problem.

Presented at the Air Transport Session, Twelfth Annual Meeting, I.A.S., New York, January 25–27, 1944.

* Chief, Aircraft Development Section.

Summary of Report

The report presents a method for correlating the take-off and landing characteristics of any airplane with its airport dimensional requirements. This method is then applied to several representative airplanes, and the dimensions for four classes of airports are determined.

The primary assumption upon which this method is based is that airport dimensions should be determined from performance characteristics that result from the normal operating technique of a large number of experienced pilots. Thus it is assumed that pilots who have acquired an appreciable amount of time in a particular airplane will have come to operate that airplane in a reasonable and safe manner and that airport dimensions determined on this basis will not be excessive.

The determination of airport dimensions as included in this method involves the consideration of meteorologic conditions likely to be encountered and the application of general requirements to the specific characteristics of the airplanes in question.

General Dimensional Standards

The general dimensional standards were determined through an analysis of some 480 take-off and landing accidents involving all types of aircraft. This indicated that runways should be long enough to permit aircraft to roll to a stop if an engine failure occurs as the wheels leave the ground, that reasonably smooth and unobstructed surfaces should be provided on either side of the runways to allow for uncontrolled swerving from the original flight direction, and that obstacles in areas surrounding the airport be limited in height to provide reasonable clearance for climb-out, approach, or emergency turn procedures.

Meteorologic Considerations

The qualifying meteorologic considerations involve flight operations on hot summer days. At such times temperatures and barometric pressures combine to effectively raise the airport's "atmospheric" or density altitude several thousand feet above its geographic elevation. Analyses of thermograph and barograph records covering several seasonal cycles indicate that, at sea level, airport dimensions should provide for a density altitude of 3,200 ft.

Performance Characteristics

The performance characteristics as determined by normal day-by-day operating technique were obtained photographically. Thus, space-time records involving eight representative models at various airports and at various elevations were obtained.

In recording normal flight operations, no restrictions were imposed upon the piloting technique. In fact, the pilots were not always aware that photographs

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"For these reasons, we hope that Republic will be able to maintain full employment with only 20% of its present annual sales volume.

"But, employment figures will not work for us unless we work for them. If we put into merchandising *all the brains and energy we have put into war production, no aircraft plant, or anybody who wants to work in one, need be idle."*

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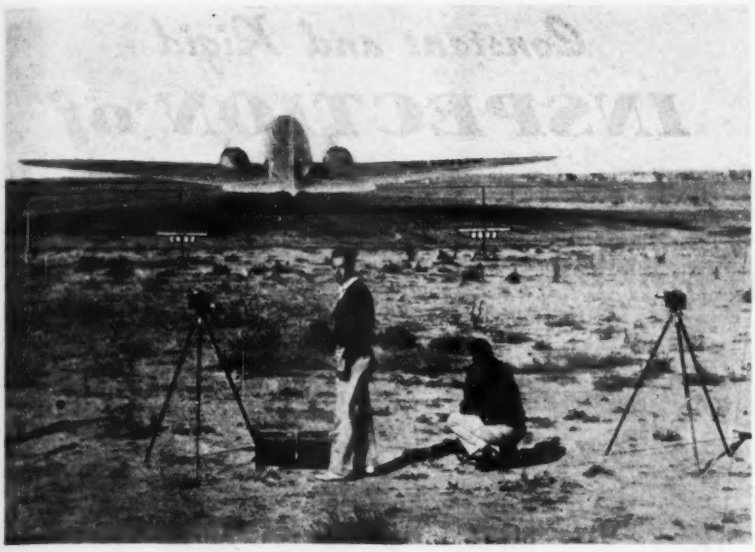

Photographic flight path recording equipment used to obtain space-time records of take-off and landing characteristics.

were being taken. As would be expected, this procedure results in considerable divergence between individual records, and a large number of observed data are required to define performance curves in an adequate manner. Experience in this connection has indicated that for each airplane approximately 210 records should be obtained. These should include (a) 30 normal take-offs and 30 normal landings at three widely different elevations and (b) 30 braked landing rolls. In addition, and for at least one air transport type, 30 instrument approaches with the pilot under the hood should be obtained.

Because of certain contingencies that arose during the progress of the investigation, it was not possible to obtain that number of records for each airplane considered in our program. The 560 records that were obtained, however, were so distributed that the normal operating characteristics of one model at various altitudes and the sea level characteristics of four other models were reasonably determined from the photographic records.

Observed Performance Characteristics

The observed performance characteristics included unstick distance, unstick speed, distance to climb to 50 and 100 ft., distance to descend from 100 and 50 ft. to contact, contact speed, and braked ground roll distance. Those data were corrected to zero wind and to specification gross weight and were plotted against altitude. The resulting curves did not average the points but defined the conservative boundaries of their envelopes. It is believed that this procedure will obtain airport dimensions that will safely accommodate all normal day-by-day take-offs and landings. Fig. 1 illustrates the method employed in plotting the recorded characteristics and the divergence of values

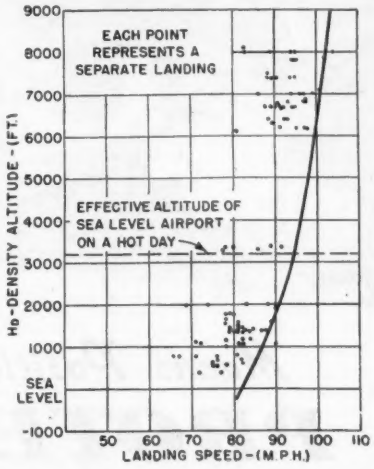

Fig. 1. Photographically recorded landing speeds, DC-3.

obtained during normal operating procedure. A curve that averages the points would result in airport dimensions that would accommodate only 50 per cent of the normal landings.

The airport requirements for airplanes still in the design stage or for any airplane whose normal operating characteristics have not been obtained from photographic space-time records can be obtained from the recorded characteristics of similar type airplanes. To accomplish this, the optimum performance of both the proved and unproved airplanes are computed using a standardized, and therefore comparable, method of computation. The ratios of recorded to computed values, termed "spread coefficients," are then applied to the computations for the unproved airplane to determine its normal operating characteristics. This method was applied to three additional models.

Thus, the methods outlined above were applied to the photographic records to obtain the take-off and landing paths of eight representative models as follows:

Model A—Aeronca K
Model B—Fairchild 24
Model C—Howard DGA-8
Model D—Lockheed 14
Model E—Boeing 247-D
Model F—Douglas DC-2
Model G—Douglas DC-4
Model H—Douglas DC-3

These, together with recommended runway lengths and obstacle limits for four classes of airports, are shown in Fig. 2 and involve normal operations at sea-level airports on hot summer days with no wind. Table 1 lists the runway lengths and obstacle zoning ratios shown in Fig. 2.

No take-off flight paths that involve a partial loss of power are shown in Fig. 2. These were omitted because the accident records indicate that the pilot's reactions and, therefore, the performance actually realized under such conditions are somewhat doubtful. It is significant, however, that during normal operations the air speeds that correspond to

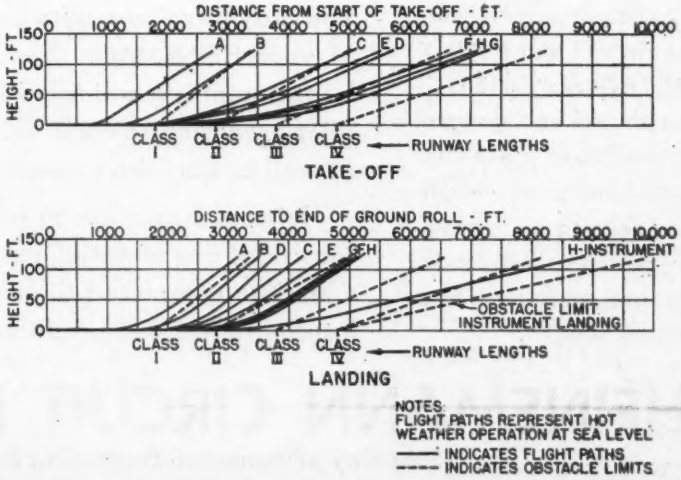

Fig. 2. Airplane flight paths and recommended airport dimensions.

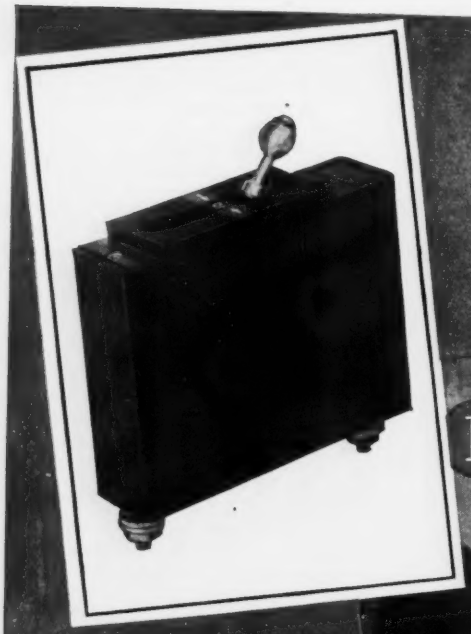

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TABLE 1

Class of Airport	I	II	III	IV
Runway length (ft.)	1,800	2,800	3,800	4,800
Obstacle zoning ratio	13	18	23	28
Obstacle zoning ratio (instrument approach)		43		

the take-off distances, which are shown in Fig. 2, are the speeds for minimum power. This favors the possibility of continued flight in the event of a partial loss of power during the take-off.

With further reference to Fig. 2, airplane Model A was selected to determine the requirements for Class I airports because its performance was less favorable than others of the lower powered private-owner types. The flight paths of air-carrier type models F, G, and H, on the other hand, are such as to require greater runway lengths and more drastic obstacle limitations than any of the other models considered. These determined the requirements for Class IV airports. Intermediate values for Class II and Class III airports were arbitrarily chosen.

Through necessity, the normal operating characteristics for Model A had to be determined through the application of spread coefficients rather than directly from observed data. However, the characteristics of a similar type airplane were well defined by photographic records. It is of particular interest to note that for Model H, photographic records of 102 take-offs, 106 landings, and 31 instrument approaches were obtained.

Recommended Runway Lengths

The recommended runway lengths for Class I and Class IV airports are sufficient to permit the airplanes involved to brake to a stop if the engines fail as the wheels are just leaving the ground and their obstacle limitations provide reasonable clearances for climb-outs and approaches. In a similar manner, Class II airports will safely accommodate airplanes similar to Model B and airplanes whose normal operating characteristics approximate the recorded performances of Models C, D, and E would use Class III airports. When operated by experienced pilots the take-off speeds for all airplanes considered correspond to the speeds at which level flight power requirements are a minimum.

To allow for uncontrolled swerving from original flight paths, the report recommends that between parallel runways—or from a runway to the boundary of the airport; or from a runway to any area occupied by buildings, parked aircraft, or automobiles—the following distances be provided:

Class I airports—150 ft.
Class II airports—300 ft.
Class III airports—450 ft.
Class IV airports—600 ft.

As previously stated, the flight paths shown on Fig. 2 apply only to sea-level airports and were largely derived from the photographic records. However, since the normal operating characteristics at various altitudes were recorded for but one of the eight airplanes considered, it was necessary to determine the effect of elevation on airport dimensions through the application of aerodynamic theory. In so doing it was assumed that airplanes using Class IV airports would be equipped with superchargers but that the power of the airplanes operated on Class I, II, and III airports would be reduced at higher altitudes. Thus, suggested runway lengths and obstacle zoning ratios for elevations up to 10,000 ft. and assuming no wind were so determined. A comparison of the computed values for Class IV airports at various elevations with the requirements for airplane H, as determined entirely from recorded data at various elevations, indicated that in this case the computed values are conservative by approximately 3 per cent.

Directional Requirements

No matter how many runways are provided, dimensions in the direction of at least one of them must provide for zero wind conditions. However, it appears practical to reduce the dimensional requirements for the remaining runways to allow for the beneficial effect of winds on take-off and landing characteristics. Since this would result in an appreciable saving in cost, an analysis of this possibility is presented as an appendix to the report.

In this analysis prevailing winds are not considered. Instead, the recommended reductions in runway lengths and obstacle zoning ratios are intended to provide for any wind and involve two assumptions: first, that the use of any runway will be abandoned whenever the velocity and direction of any wind result in a cross-wind component (Vc) which approximates 10 m.p.h.; second, that its use will be abandoned whenever its longitudinal wind component (V_L) is less than the wind velocity used in determining its dimensions.

It immediately is recognized that for any airport arrangement winds that roughly bisect the angle between any two adjacent runways can attain velocities that result in dangerous cross-wind components for all of the runways. This possibility may require consideration of prevailing winds in certain localities. However, to cover various possible runway arrangements, the report considers the effect of general wind conditions on the dimensioning of airports having two, three, and four runway directions.

Two Runway Directions

Where two runway directions are concerned, it first is assumed that the angle between the cross runway and the zero wind or long runway will not be less than 60°. On this basis, and if the airport dimensions in the direction of the cross runway have been determined so that they will safely accommodate flight operations with at least a 10 m.p.h. longitudinal wind component, it may be used whenever winds that are roughly at 90° to the long runway attain velocities that appreciably exceed 10 m.p.h. The main runway can be used until its cross-wind component appreciably exceeds 10 m.p.h. With only two runway directions, a wind that bisects the larger of the two angles of runway intersection and which appreciably exceeds 12 m.p.h. will result in serious cross-wind components for both runways. Three runway directions will relieve this situation.

Three-Direction Airports

In the case of three-direction airports, it is assumed that the angle between one of the cross runways and the main runway will not be less than 60°. It further is assumed that the angle between any two adjacent runways will not be less than 50°. On this basis the angle between any two adjacent runways will not exceed 80°, and a wind that bisects that angle would have to attain a velocity of 20 m.p.h. in order to result in serious cross-wind components for all runways. If a three-direction airport is arranged in this manner and if both cross runways safely provide for operation with longitudinal wind components of at least 10 m.p.h., operations may be transferred from the long runway to one of the cross runways whenever winds that appreciably exceed 15 m.p.h. cross the long runway at an angle of approximately 45° or whenever winds greater than 10 m.p.h. cross the long runway at roughly a 90° angle.

Four-Direction Airports

In considering a four-direction airport, it is assumed that the angle between any two adjacent runways should not be less than 35°. This can result in a maximum angle of 75° which, if bisected by winds in excess of 20 m.p.h. will result in a serious cross-wind component (Vc) on all runways. With a four-direction airport arranged in this manner, one of the three cross runways will make an angle of from 70° to 90° with the long runway and can be dimensioned for a longitudinal wind component (V_L) of 10 m.p.h. This will be referred to as the first cross runway and will be used whenever winds that exceed 10 m.p.h. are roughly at right angles to the main runway. The remaining two cross runways, referred to as the second and third cross runways however, may be further reduced so that at least a 15-m.p.h. longitudinal component (V_L) will be required to make their use safe. Either of these may then be used until their longitudinal wind components are less than 15 m.p.h. at which point operations may be transferred either to the long runway or to the first cross runway, since their longitudinal and cross-wind components will safely permit their use. It is of interest to note that, if a four-direction

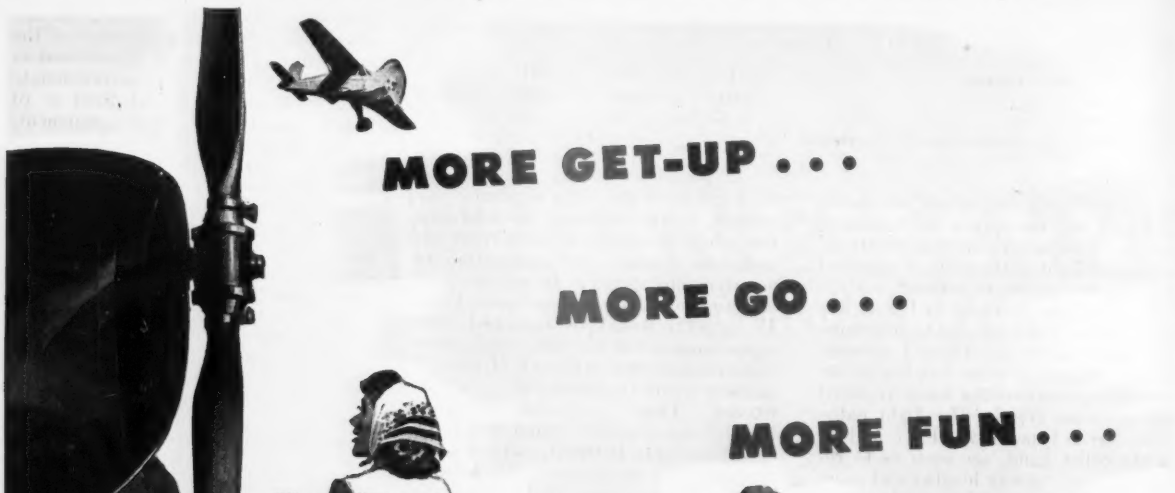

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TABLE 2
Recommended Runway Directions and Wind Velocities

Number of Runway Directions	1	2	3	4
Minimum angle between first cross runway and zero wind or long runway	..	60°	60°	70°
Minimum angle between any two adjacent runways	..	60°	50°	35°
V_L long runway (m.p.h.)	0	0	0	0
V_L first cross runway (m.p.h.)	..	10	10	10
V_L second cross runway (m.p.h.)	..	..	10	15
V_L third cross runway (m.p.h.)	..	..	..	15

NOTE: (1) No runway will be used unless its longitudinal wind velocity component (V_L) exceeds the value listed in this table. (2) No runway will be used if its cross-wind component (Vc) approximates 10 m.p.h.

airport is symmetrically arranged (45° between adjacent runways) and with dimensions along three of the cross runways reduced as suggested, it may safely be used with winds from any direction having velocities from 0 to 30 m.p.h.

To summarize the previous discussions, the recommended angular arrangement of runways and the longitudinal wind velocity (V_L) to be used in determining how far dimensions may be reduced are listed in Table 2.

Effect of Wind

The longitudinal wind velocity components (V_L) are translated into reduced airport dimensions through the use of runway length reduction factors (K_r) and obstacle zoning ratio reduction factors (K_z). These are then applied to zero wind requirements to obtain the reduced values. Since airport engineers may desire to use other values of (V_L) than those listed in Table 2, the report presents a series of curves from which values of (K_r) and (K_z) may be obtained for any value of (V_L) up to 30 m.p.h. and for any elevation up to 10,000 ft. These cover Class I, II, III, and IV airports.

In the report, the reduction factors (K_r) and (K_z) corresponding to the velocities (V_L) listed in Table 2 are applied to the zero wind requirements to obtain the reduced dimensions for cross runways for Class I, II, III, and IV airports and for elevations up to 10,000 ft. These are presented as curves that show runway lengths and obstacle zoning ratios and involve values of (V_L) of 0, 10, and 15 m.p.h. Figs. 3 and 4 show these curves for Class IV airports. The dimensions involving $V_L = 0$, of course, are greatest and are required for at least one runway direction. If three runway directions are provided, the two cross runways should be dimensioned by the curves involving a wind velocity of 10 m.p.h. If four runway directions are provided, the dimensions for the runway that crosses the long runway at approximately 90° should be in accordance with the 10 m.p.h. wind curves, while the dimensions for the remaining two runways should be in accordance with the 15 m.p.h. wind curves.

While it is assumed that airplanes using Class IV airports will use superchargers, it is necessary to make those airports large enough to accommodate the smaller air-carrier type aircraft that may not be so equipped and which normally would be operated on Class III airports. However, at certain altitudes, the normal operating characteristics of such airplanes would not be safely accommodated by Class IV airports, the dimensions of which assumed the use of superchargers. This explains the sudden breaks in the curves shown in Figs. 3 and 4. In effect, and at the altitudes where those breaks occur, the requirements for Class III airports exceed the Class IV dimensions that would obtain if they were determined from the performance of supercharged airplanes of the largest air-carrier type.

It is estimated that for a four-direction, Class IV airport at sea level, reductions in the lengths of all but one runway as suggested would represent a saving in the cost of paving alone of more than $200,000. Further reductions in paving cost would result from the use of runways having only the central portions of their lengths paved. With such an arrangement the paved portion would provide for normal take-off and landing ground runs. However, reasonably smooth landing strips extending beyond both ends of the pavement would be necessary. This will require landing strips that are 40 per cent longer than would be required if their entire length were paved. Thus, a 40 per cent reduction in paving length would require a 40 per cent increase in total length and, of course, a 40 per cent increase in the size of the airport. Such an arrangement, however, might prove economical in certain localities.

COMMENTS

Although the years that have transpired since the completion of the report have seen the construction of airports considerably larger than those recommended in the report, it is felt that nothing has arisen which invalidates the method presented and that the recommended airport dimensions are adequate for the safe and practical operation of the airplanes considered. The application of this method to recently developed airplanes may or may not indicate the need for airports larger than Class IV as recommended in the report.

Had it been possible to continue the work of obtaining photographic records as originally planned, the airport requirements for all models considered at sea level and at various elevations could have been determined directly through the application of observed data, and there would have been no need to resort to aerodynamic computation. Also, a more complete basis for determining spread coefficients would have resulted. However, in the air transport category complete records were obtained.

It is difficult to compare the airport dimensions recommended in the report with the current Civil Air Regulations that concern take-off characteristics. These specify certain minimum requirements, whereas the recommended airport dimensions result from normal operating procedures. However, it is interesting to note that the dimensions recommended for a Class IV airport will safely accommodate the take-off of airplanes H and G, when operated in accordance with those regulations, and that the unstick speeds for all of the models considered in the report, which result during normal operations, closely approximate the speed for minimum power. This favors continued flight at partial power as specified in the Civil Air Regulations.

Observed Wind Velocities

The report includes methods for correcting observed characteristics for observed wind velocities. In this connection, it is of interest to comment upon the characteristics of winds as actually encountered. In attempting to obtain wind velocities in connection with this investigation, it was noted that even at a single location the direction and velocity of the wind varied widely over relatively short time intervals. Because of this, only a rough approximation of the wind velocities and directions that affect the take-off and landing characteristics is possible. The methods of computation used in the report to correct observed performance characteristics to zero wind and to determine the increase in wind velocity with height therefore are considered adequate even though more exact methods may now be available.

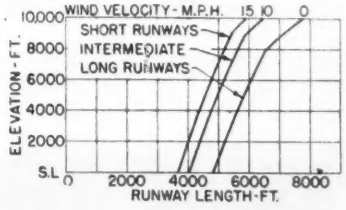

FIG. 3. Runway lengths versus altitude, Class IV.

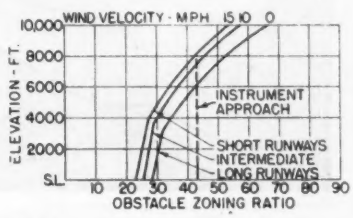

FIG. 4. Obstacle zoning ratios versus altitude, Class IV.

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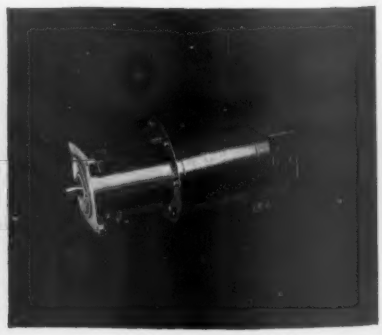

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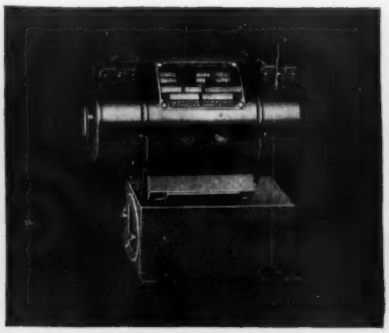
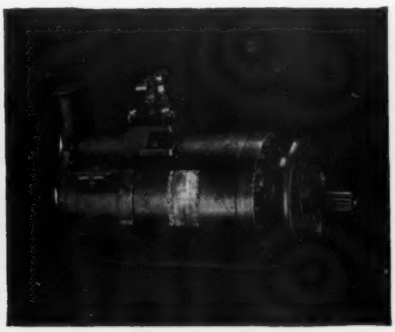
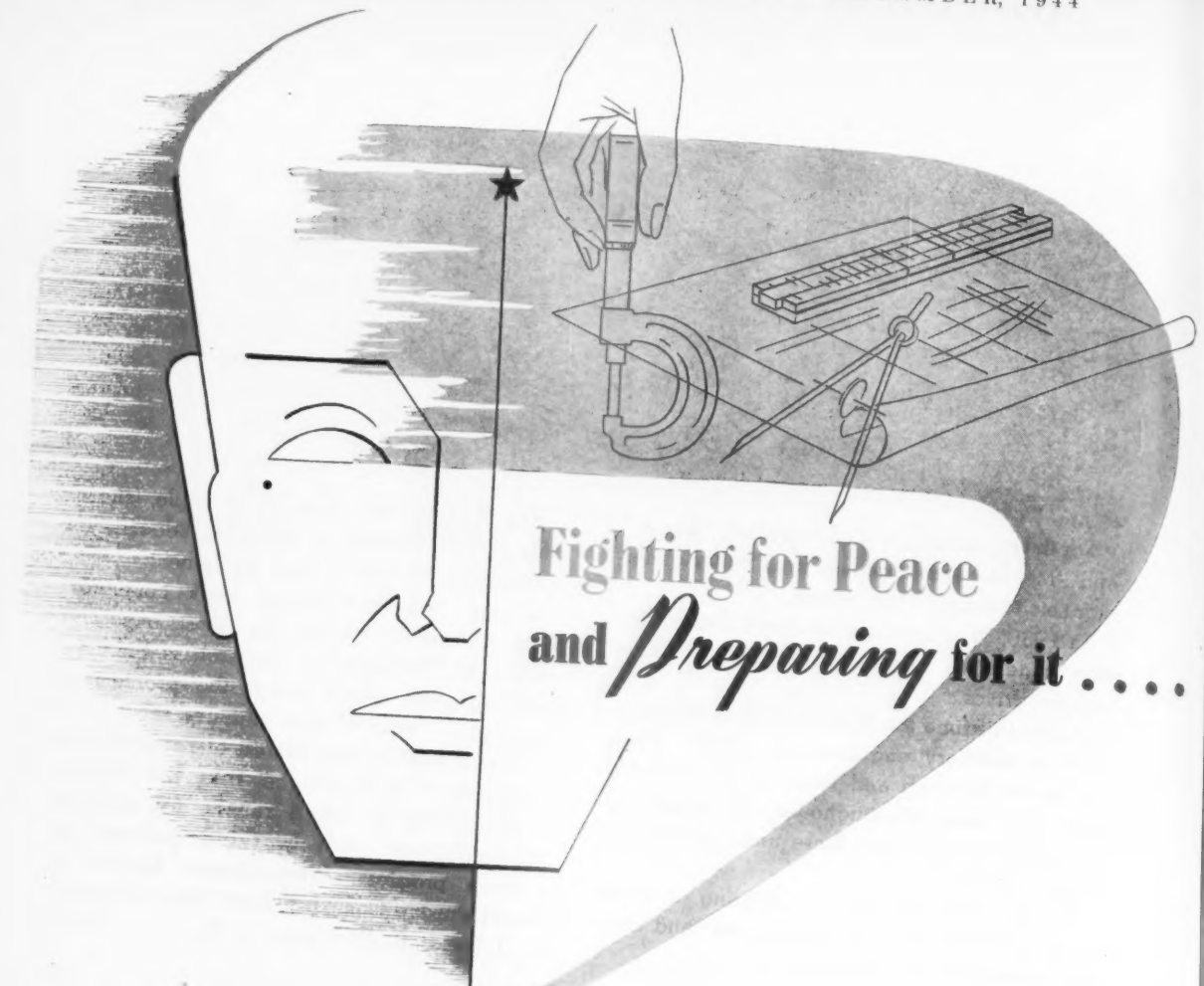


Westinghouse first introduced this minimum ripple dynamotor for radio communication use (1931).

Note the trend towards modern streamlined compactness in this later Westinghouse dynamotor (1934).



This modern Westinghouse 28.5-volt d-c generator (type P-1) helps power the great bomber fleets of today.



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CONTROL SYSTEMS

Minimum Distances between Parallel Runways

There appears to be no rational basis for determining minimum distances between parallel runways. As indicated in the report, a minimum separation of 600 ft. for Class IV airports was suggested by actual accident records. However, continued experience may indicate the need for greater distances. It is suggested that, in general, runway separation distances should be roughly proportional to the take-off speeds of the aircraft involved.

Obstacle Limits

The report contains no recommendations concerning obstacle limits in the turning zones. However, this has been given considerable study since the completion of the report. Thus, it is assumed that a partial loss of power during the take-off, requiring the circling for an emergency landing, is the critical condition. On this basis and assuming further that a turn under such conditions can be effected without loss of altitude, it is indicated that obstacle zoning ratios in turning zones be no less than the ratios in the approach zones, except that allowances must be made for buildings on and adjacent to the airport. Therefore, it is recommended that in the turning zones and for all classes of airports obstacle heights be restricted to the same values recommended for approach zones, except that obstacle heights need not be reduced below 75 ft.

The determination of reductions in dimensions for cross runways to allow for winds is based upon the assumption that the use of any runway should be abandoned whenever its cross-wind component approximates 10 m.p.h. This value has no experimental basis for its determination and is not considered in the Civil Air Regulations. Pilots' opinions vary. Thus, cross runway components as high as 25 m.p.h. have been suggested depending upon the type of aircraft involved. Since these runways must accommodate all types of aircraft, an assumed value of 10 m.p.h. is considered reasonable, especially since substantial decreases in the size and cost of airports result when this value is used as a basis for determining reductions in runway lengths and obstacle zoning ratios.

In general, it is felt that the report presents a reasonable method of approach to this problem and that the application of that method results in an adequate approximation of airport dimensions that will provide reasonable safety.

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[4] Wetmore, J. W., *The Transition Phase in the Take-Off of an Airplane*, N.A.C.A. Report No. 626, October, 1937.

[5] Oswald, W. Bailey, *General Formulas and Charts for the Calculation of Airplane Performance*, N.A.C.A. Report No. 408, 1932.

[6] Schrenk, Martin, *Calculation of Airplane Performance Without the Aid of Polar Diagrams*, N.A.C.A. T.M. No. 456; Translation from the 1927 Yearbook of the "Deutsche Versuchanstalt für Luftfahrt."

[7] Ryburn, W. E., *Instrument Approach Performance Characteristics on Radio Instrument Landing Systems*, Technical Report No. 32, June 1943, Technical Development Division, Civil Aeronautics Administration.

[8] Fales, Elisha N., *Equipment for Recording Airplane Take-Off and Landing Characteristics*, Flight Engineering Report No. 8, November 1943, Flight Engineering and Factory Inspection Division, Civil Aeronautics Administration.

(*Continued from page 23*)

Response of the Control Mechanism

Extensive tests of the first experimental propeller indicated that the response of the control mechanism, particularly to small off-speeds, may be somewhat improved by substituting a chain in place of the V-belt for the fixed ratio drive. This arrangement, by preventing any possibility of slippage or creep, assures that the speed sensitive flyweights on the governor unit will always rotate at a positive ratio of the propeller speed which is considered an essential requirement for precise constant speed control. Moreover, it is found that the use of the chain drive permits a slightly more compact control mechanism.

Accordingly, a roller chain fixed ratio drive is incorporated in the present production design (see Fig. 2), the V-belt, of course, being retained for the variable ratio drive. The use of V-belts for both drives, as shown in Fig. 1, is somewhat preferable from the standpoint of cost and may be resumed in future designs, except perhaps for applications in which close precision of governing is required. Numerous tests of the roller chain drive have indicated satisfactory reliability, and its use is considered practicable, although the original V-belt fixed ratio drive may prove preferable where low cost is a vital consideration.

The ISO-REV propeller promises to contribute toward a more efficient prosecution of the war by supplying a distinct need in the military aircraft field. Moreover, when private flying is resumed following the present war emergency, its availability will do much to foster private flying by making possible much needed improvements in light airplane performance.

Conclusions

(1) The variable ratio V-belt principle, when applied in the design of a governor mechanism, makes possible a simple, reliable, inexpensive constant-speed propeller particularly suited to the requirements of low and moderate horsepower.

(2) Speed sensitive flyweights, utilized to regulate the pitch-changing action of the variable ratio drive, assure precise constant-speed control, unaffected by variations in twisting forces on the blades.

(3) The natural damping action of a variable ratio V-belt drive, when applied in the design of a constant-speed control mechanism, affords quickly responsive governing action without danger of hunting. Variations from the control speed produce a rate of pitch change proportional to the required correction.

(4) A V-belt drive will give reliable service over long periods of time with only occasional inspection and is not normally affected by atmospheric conditions; hence, it is well suited for a rugged constant-speed propeller control mechanism suitable for varying conditions of service.

(5) The ISO-REV constant-speed control mechanism is a self-contained unit that utilizes engine power for pitch changing, precluding the necessity for auxiliary power sources.

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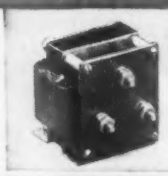

Operates Types KB-1 and KC-1 gyro instruments in aircraft equipped with 750-va Holtzer-Cabot inverter
Input: 26 volts and 115 volts
Output: 115 volts, three-phase, 400 cycles
Ask for Bulletin GEA-4113

Three-phase to Single-phase Transformer

Provides single-phase power for operation of the radio compass and other instruments and accessories
Input: 115 volts, 400 cycles, three-phase
Output: 115 or 26 volts, 400 cycles, single-phase
Ask for Bulletin GEA-3881

Ballast and Transformer

Operates two or four 4-watt MAZDA F lamps for instrument, indicator and panel lighting; also provides 3 volts (5 or 10 amp) for indicator and instrument rim lights
Input: 110 volts, 400 cycles
Ask for Bulletin GEA-3859

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Will operate one 4-, 6-, 8-, 15-, or 20-watt MAZDA F lamp for fluorescent lighting of commercial aircraft, depending upon rating selected
Input: 118 volts, 400 cycles
Ask for Bulletin GEA-3860

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Input: 117 or 203 volts, 400 cycles
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Inverter Ballast (d-c to a-c)

Provides suitable output voltage for operation of two 4-watt MAZDA F lamps for instrument-panel lighting; also provides 3 volts (1.5 amp) for operation of indicator lights
Input: 12 or 24 volts, d-c
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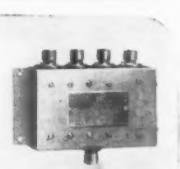

Operates four 4-watt MAZDA F lamps for instrument-panel lighting
Input: 26 volts, 400 cycles
Ask for Bulletin GEA-3908

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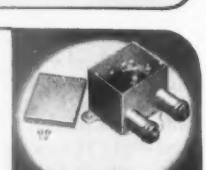
Furnishes proper a-c voltage for operation of 400-cycle aircraft instruments, such as the remote indicating compass
Input: 110 to 120 volts, 400 cycles
Ask for Bulletin GEA-4260

Ignition Booster Coil (d-c)

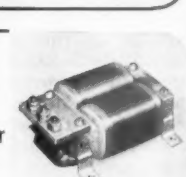
Provides ample and positive spark for starting aircraft engines at low magneto speeds
Input: 12 and 24 volts, d-c
Ask for Bulletin GEA-3861

Starting Vibrator



Provides pulsating, low-voltage current directly to the low-voltage winding of the magneto for instant starting of the engine
Input: 1.8 amperes at 24 volts, d-c
Ask for Bulletin GEA-4105A

Single-phase Autotransformer



Provides proper voltage for operation of 28-volt lamps, electrically heated flying suits, and other low-voltage accessories on aircraft
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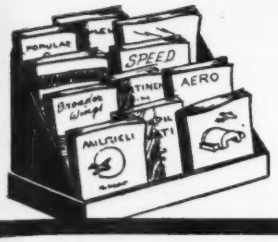

Periodicals

Accessories and Equipment

Methyl Bromide vs. Carbon Dioxide for Quenching Aircraft Fires. C. H. Lindsay. Methyl bromide is stated to offer certain advantages over carbon dioxide as a medium for an aircraft fire-extinguishing system that will service the power-plant sections as well as the accessory compartment. Comparative pressures of methyl bromide and carbon dioxide throughout the desirable temperature range are contrasted to the advantage of the former. Methyl bromide is reported to require less weight and space, and the toxic qualities of methyl bromide are analyzed as offering no greater hazards to personnel than carbon dioxide. On the latter point, it is stated that methyl bromide has been approved for use by the Civil Aeronautics Authority.

A particular methyl bromide fire-extinguishing system for aircraft is described. This system, manufactured by the American-LaFrance-Foamite Corporation, is called "Broamite." It is developed about a cylinder (or series of cylinders) and a cylinder valve. Actuation of the valve is accomplished by the opening of a solenoid-operated pilot valve. Both the pilot valve and discharge valve are of the poppet type, tightly seated by the internal cylinder pressure. *Aero Digest*, October 1, 1944, pages 120, 122, 124, 222, 7 illus.

Vision Unlimited. Ben F. Field. Developments in goggles for American military fliers are reviewed. Noting the limitations of the standard B-7 goggle, as well as those used by British pilots, the writer goes on to describe improved types of goggles which have been devised. These include goggles with electric heating attachments, dark-adaptation goggles, antiglare goggles, and camouflage-detection goggles. By making it possible for airmen to wear one set of goggles containing lenses for all emergencies, the Polaroid Aviation (B-8) goggle is indicated as the culmination of all these developments. *Flying Aces*, November, 1944, pages 21, 66, 69, 5 illus.

Sealing Aviation Fuel-System Equipment. T. R. Thoren. Indicating that synthetic-rubber seals have proved a convenient and satisfactory solution to the problem of sealing aviation fuel-system equipment, the writer continues with a detailed discussion of the development of seals for fuel-booster pumps, selector cocks, and engine-driven pumps. A typical fuel system is used as a basis for the discussion. Tables gives the composition of aromatic test fuel, the physical properties of diaphragm material, and the physical properties of gasket material.

In summarizing the subject the writer states that a wide variety of properties are available in synthetic rubbers. The best physical form of a synthetic-rubber part to meet the specific requirements is arrived at by making provisions in the design for the limitations of the rubber stocks available. Once the design is set and a specific rubber stock selected, close control of production quantities is necessary to assure consistent performance. *Mechanical Engineering*, October, 1944, pages 663–667, 11 illus.

Use of Rotary Pumps in Aircraft. Part 2. R. J. S. Pigott. The concluding section of a two-part article continues a discussion of the gear and vane types of rotary pumps in aircraft applications. The clearance volume of a gear pump is defined, with reference being made to the effect of presence of gas in the fluid being pumped upon the performance of the unit. A method for calculating the loss caused by "slip" is given. A comparison is made between vane pumps and gear pumps, noting that there is no tooth loss in the vane type. Port losses are explained with the aid of drawings and graphs, and recommendations are made for a simple change in the port to achieve better efficiency. The present situation in pump design is summarized, and the following suggestions are made for improving pumps for operation at altitudes of 50,000 ft.: (1) Design the pumps for low inlet loss; (2) design the piping for lower loss than is now common, eliminating all sharp ells, restrictions, and quick disconnects possible; (3) put the pump in a "drowned" position at the sump or tank and avoid all inlet piping; (4) for those cases where a considerable change of piping and pump is not feasible, arrange them for designs now flying and use low-loss boosters at the sump or tank. *Aero Digest*, October 15, 1944, pages 137, 138, 245, 6 illus.

Hydraulic Actuating Cylinder. A description is given of a simplified design of hydraulic actuating cylinder which has been developed and used on airplanes during the past year. Only a screw driver is required to dismantle and reassemble the unit. The design features of the cylinder are listed and discussed. *Air Tech*, November, 1944, pages 32, 33, 5 illus.

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Aerodynamics

Directional Stability. J. Black. Considerations in the designing of the tail of the aircraft are discussed, and problems involved in the work of obtaining directional stability are examined. Three means of achieving directional stability are outlined. The writer describes how the principles are applied to some actual aircraft and then explains how the method of obtaining directional stability will affect the actual flying of the aircraft. *Aeronautics*, October, 1944, pages 38–42, 5 illus.

Some Aspects of Wing Design. S. J. Smyth. An analysis is made of the factors involved in the selection of a wing design to give the least possible drag at some predetermined speed. It is noted that the laminar-flow section has the lowest drag coefficient, but extremely smooth finish is required. To obtain the requisite degree of smoothness, the thickness of the wing section must be increased, thereby increasing the weight of the wing and of the entire airplane. For that reason greater wing area is required so that constant wing loading may be maintained. It is assumed that a point may be reached where the reduction in drag coefficient is offset by the increase in wing area, in which event the problem becomes a matter of determining the extent to which it is permissible to increase the weight by thickening the skin in order to obtain a reduction in drag. A formula is derived for computing this limit.

The choice of aspect ratio involves a similar type of problem. An increase in aspect ratio results in a reduction in induced drag but leads to a greater weight of wing. The consequent increase in wing area required to maintain constant wing loading will give a greater profile drag, and this may offset the advantage obtained by the reduction in induced drag. By the assumption of a formula for wing weight in terms of aspect ratio, it is shown that an upper limit for the aspect ratio can be fixed for a particular case. *Aircraft Engineering*, September, 1944, pages 262, 263, 2 illus.

Effects of Compressibility. G. L. Shue. Compressibility and its increasing importance with higher aircraft speeds are discussed. Five effects of compressibility which have been observed are listed. It is stated that wing compressibility has received little attention thus far because the problems of propeller compressibility have been more urgent. However, the development of jet propulsion promises to eliminate the latter while accentuating the former. The quantitative prediction of the behavior of an airfoil at high speed is discussed. *Industrial Aviation*, October, 1944, pages 59, 97, 2 illus.

Air Cargo

Ground Handling of Air Cargo. M. B. Crawford. This article discusses some of the features of an experimental program with cargo-handling equipment which is being worked out by United Airlines' engineers. The ultimate objective of the program is the development of practical ways of moving cargo in and out of the large planes now being designed, but the immediate object is to get equipment that can be used now. Sections of the article discuss reducing the amount of handling, fork trucks, cargo chutes, power-belt loaders, and special lift tracks. *Distribution and Warehousing* (*D and W*), October, 1944, pages 48–50, 5 illus.

Transoceanic Air Cargo. Lt. Comdr. Neil MacCoull. In this examination of the fundamentals of air-cargo transport the writer simplifies the complicated subject by assuming values for some of the less important variables that are consistent with practice and may be obtained for specific conditions of flight, if not for a wide range of conditions in any one plane. The division of useful load into fuel and cargo is first considered. To compare planes with each other, a term called "ultimate range" is introduced, which is the range possible in still air if all the useful load were given up to fuel. The effect of speed on the quantity of cargo that may be delivered is next examined. A term called the "delivery factor" is introduced as a means of comparing various aircraft on this basis. Attention is given to both the airplane and the airship as cargo carriers.

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delivery factor when the fuel used is one-third of the useful load or one-half of the cargo load, regardless of the length of voyage or size of the craft. This means that the airship's speed for maximum delivery factor would be adjusted so as to consume one-third of its useful load as fuel, regardless of the length of the voyage. Another point of comparison is the fuel used per ton-mile, which may be a matter of considerable importance where there is a fuel shortage. This is where the airship has a pronounced advantage over the plane, especially on long voyages.

In conclusion, it is shown that the fact that an airship can fly at moderate speeds well below those of airplanes makes possible higher delivery factors for extremely long voyages than for planes, these airship speeds being well in excess of surface speeds at sea. *SAE Journal*, October, 1944, pages 445–459, 485 (Transactions), 14 illus.

Procedure for Handling Imports by Air. George F. Bauer. The writer suggests the use of a competent customs broker as a means of avoiding handling difficulties. The need for manufacturer to familiarize himself with constantly changing conditions and regulations that require the attention of specialists in this field is stressed. It is explained that this can be done by the American manufacturer signing a form that authorizes a customs broker to do the detail work incidental to the importation. Details of the procedure are described and forms for the purpose are illustrated. *Distribution and Warehousing (D and W)*, October, 1944, pages 79, 129, 131, 3 illus.

Air Law

Am I Responsible? Paul V. McNamara. An investigation is reported of the problems and confusion attendant upon the question of air liability. It seeks to determine what factor or factors in the conduct of flight operations as private owner, private pilot, commercial owner, or commercial pilot will result in legal culpability in the event of some mishap that causes personal or property damage to others. Because of the lack of legal precedents as to what constitutes reasonable care in the conduct of flight operations, the operator or owner is advised that the only feasible solution at the present time is to invest in comprehensive insurance coverage. *Air Facts*, November, 1944, pages 52–56.

Air Policy

Canada's Policy. William Kroger. This article discusses Canada's air policy and indicates that Canadians now view the United States and Canada as an aeronautical entity. This is stated to be true particularly because an extension of Trans-Canada Air Lines between Winnipeg and Toronto, passing over a part of the United States, would give Canada a shorter and faster route between the northwestern part of the United States and New York. *National Aeronautics*, October, 1944, pages 21–23, 3 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

The Chosen Instrument. William L. Grossman. The "chosen instrument" issue is discussed and consideration is given to who ought to decide it. An analysis is made of the McCarran bill and of the factors affecting the carriage of air mail. Four distinct kinds of chosen instrument are defined. It is suggested that the Civil Aeronautics Board and the President should make the immediate decision. *Air Transport*, October, 1944, pages 59, 60, 63, 1 illus.

Air Power

The Luftwaffe as a Political Instrument. H. J. A. Wilson. In this article it is stated that the Luftwaffe was founded for a political, as well as a military task, although the former has never been fully recognized. According to the writer, the political task that was entrusted to the Luftwaffe was the result of strategic, economic, and, in the broadest use of the word, political considerations. These are discussed in considerable detail. *Aeronautics*, October, 1944, pages 36, 37.

Air Siege of Japan. Alexander Kiralfy. An interpretation of Allied air strategy in the Pacific. The strategy is noted as being based upon three fundamental operations: the bombing of Japan; the air attack upon industrial-military targets in Japanese-dominated Asia; and the destruction of the enemy's supply lines at their bottleneck around the island of Formosa, between Japan and the Philippines. The discussion stresses the importance of the last. It is explained how the Allied air campaign is directed at taking advantage of the fact that long distances separate supply sources in the south from Japanese industrial centers in the north. Attention is also given to Japan's vulnerability in having to dissipate her air forces to protect such widespread areas. *Flying Aces*, November, 1944, pages 18–20, 69, 70, 2 illus.

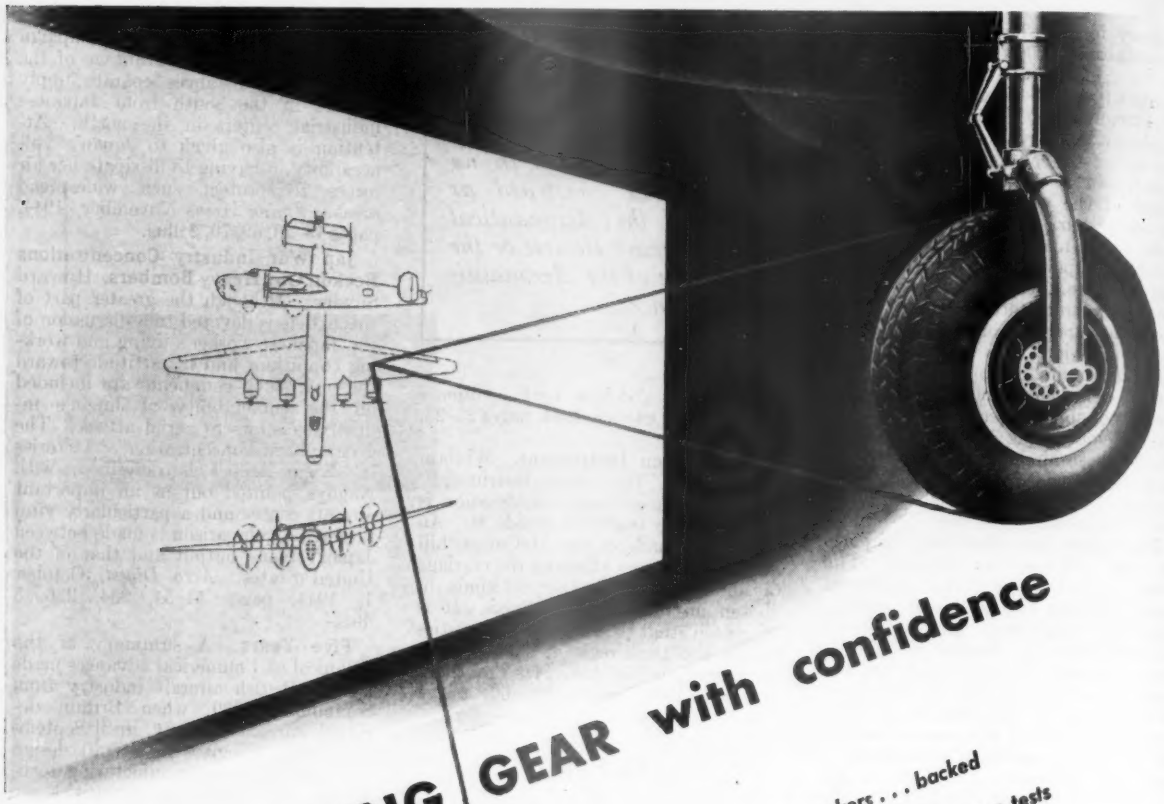
The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Jap War Industry Concentrations Beckon Our Heavy Bombers. Howard Snyder. Although the greater part of this article is devoted to a discussion of the Japanese worker's living and working conditions and his attitude toward the war, some comments are included on the vulnerability of Japan's industrial centers to aerial attack. The geographical concentration of factories in Japan proper is described, with Nagoya pointed out as an important aircraft center and a particularly vital target. A comparison is made between Japan's plane output and that of the United States. *Aero Digest*, October 1, 1944, pages 51–54, 234, 236, 5 illus.

Five Years. A summary of the technical and numerical advances made by the British aircraft industry from September, 1939, when Britain declared war on Germany, until September, 1944. Progress in aircraft design and performance, manufacturing techniques, and production quantities are noted. *Flight*, August 31, 1944, page 237.

Air Power in Action. Tom Ashley. A comparison is made of enemy and Allied plane losses in various theaters of operation. Numerical daily losses are listed from August 26 through September 25, 1944, for Western Europe, Italy, Southwest Pacific, and Russia. Monthly totals are reported for China, the general Pacific area, Southeast Asia, and the Middle East. Chart for all theaters—the European theater, the Mediterranean area, and the Asiatic area—illustrate the comparative losses from January 1 through September 25, 1944. For all theaters, there is stated to be an enemy plane-loss ratio of 1.65 to 1 in favor of the Allies (exclusive of Russian claims, since Russia lists only enemy losses and not her own). *Southern Flight*, October, 1944, pages 78, 79, 4 illus.

Flexibility of Air Power. Brig. Gen. Henry J. Reilly. Explaining what he means by tactical, strategical, and technical flexibility, the writer contends that the Allies are not making full use of the flexibility of aviation. It is his opinion that, while bombing the "enemy's means to make war" is a helpful supplement to air power's main purpose, its primary employment should follow the Napoleonic idea of crushing the enemy in the field. According to his beliefs, air power's great flexibility is of the utmost value in the assault, the break-through, and the pursuit of enemy troops. He applies his arguments to both the European and Pacific campaigns. *Flying*, November, 1944, pages 21–23, 136, 140, 3 illus.



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Air Transport

The Arctic Air Route. John Grierson. Still advocating the value and feasibility of an arctic air route, the writer revises his earlier views of how this route should be established. Rather than an "easy stage" route, he believes that a "great-circle" airway is now possible through the arctic between Europe and America. Factors principally affecting this change of conception are stated to be: first, the successful development, before the war, of the Botwood-Foynes direct Atlantic crossing; second, the progress that has been made in extending the range of aircraft since the war began. The availability of a "great-circle route" and emergency bases, created for war purposes but adaptable for civil transport after the war, is noted.

The article includes a brief review of American, British, Italian, and German arctic air-route expeditions that were made between 1921 and 1939. However, it is pointed out that all these expeditions were based on the "easy stage" route conception. *Flight*, September 14, 1944, pages 288–292, 7 illus.

How Much Competition? Part I. B. E. Cole. In this first section of a two-part article the writer states the case for a larger number of air-line operators and outlines the advantages of free competition. The development of air transport is reviewed. The record up to the year 1938, an era in which there was free competition in air transport, is compared with conditions after that date when the industry branched away from the path of free enterprise and followed a path of economic control under the provisions of the Civil Aeronautics Act of 1938. It is stated that since 1938 the rate of progress in air transport has slowed down, and activities in developing and adopting improved types of aircraft have lagged. The automobile industry and the railroads are cited as examples of the way free competition forces improvements in design and production. *Air Transport*, October, 1944, pages 35–39, 5 illus.

I Am the Captain. Capt. Robert Dawson. **I Am the Co-Pilot.** First Officer E. C. Adams. These two articles were written by a captain and a copilot working for United Air Lines. In the first article, the air-line captain traces his duties through a typical day of flight activity. In the second article, a similar interpretation is given of the copilot's job. *Air Pilot and Technician*, October, 1944, pages 4, 5, 39–41, 4 illus.

Calculating the Effect of Airport Spacing. Capt. Giles M. Reed. This is the first of a series of articles based on a study made by the writer for Pan American-Grace Airways. The subject of how variations in the rate of air-line income may result from varied airport spacing is discussed. It is explained that more refueling stops mean more "carrying power" up to the point where ground time offsets pay-load gain. Equations are suggested to determine the frequency of stops for any transport model. *Air Transport*, October, 1944, pages 65, 66, 69, 72, 75, 10 illus.

World's Longest Air Route. This is an article on the Indian Ocean air service operated by Qantas Empire Airways. Inaugurated at the request of the United Kingdom Government in collaboration with the Australian Government for the purposes of speeding air communications between Australia, India, Burma, the Middle East, and England, this 3,500-mile Indian Ocean crossing is termed the longest in the world to be flown nonstop by a regular service. The information given pertains to the establishment of the route, the aircraft used for it, pay loads, and personnel. *Flight*, September 14, 1944, pages 285, 286, 3 illus.

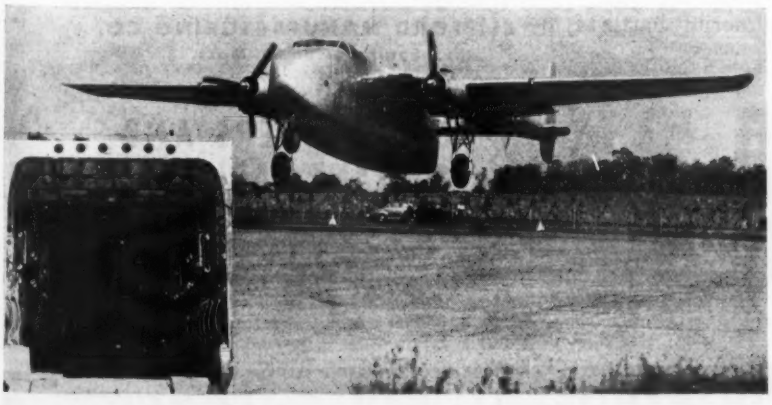
The Coming Railroad-Airlines Battle. Part II. Swanee Taylor. Second of three articles condemning the past tactics of the railroads and warning that they will use similar strategems in their attempt to enter the air transportation field. In Part II their past record is reviewed as an indication of their future course of action against the air-transport industry. The railroads are charged with having used "strong-arm" methods, bribery, etc., in their rivalry with the trucking industry. Findings of the Wheeler-Truman report are quoted to substantiate these charges.

The failure of the railroads to consolidate after the first World War, their relationships with the Association of American Railroads, and the history of the Western Association of Railway Executives are also noted and deplored. *Southern Flight*, October, 1944, pages 36, 37, 74, 3 illus.

The French Still Fly. Harold Van Dorn. A review is given of the development and operation of commercial air transport in France from the period immediately following the first World War, which is credited as the beginning of French operations.

The author traces briefly the developments from year to year, comments upon the control of the industry exercised by the government, and contains statistical tables. These give figures concerning traffic and revenues of the companies and of the combined business handled. The recent history of commercial aviation and the present operations are briefly outlined, and it is predicted that France will fill an important place in future world aviation. *Air Transport*, October, 1944, pages 30–34, 4 illus.

The Final Frontier. James C. Anderson. A report of a trip over the Northeast air route via Churchill, Manitoba. The route extends from the United States air base at Churchill, across the Hudson Bay to Southampton Island, from there to bases at Forbisher Bay on Baffin Island and Fort Chimo at the eastern end of Hudson Strait, and then out into the Atlantic. The writer's account of his experience includes observations pertinent to the construction of the bases, buildings and runways, personnel, weather conditions in the area, expenditures made by the United States and Canada in developing the route, and future possibilities of the Northeast route. *Canadian Aviation*, October, 1944, pages 60, 61, 123, 124, 126, 6 illus.



The Fairchild C-82. The inset shows a light Army tank in the cargo compartment.

Airplane Descriptions

The Rumanian Air Force. Types of planes comprising Rumanian air equipment are listed, together with the country of their origin, the purpose for which they were designed, and some descriptive data. The specifications include information as to the power plant, span, length, and maximum speed of each aircraft, as well as the conditions under which it was manufactured or supplied to Rumania. British, Italian, German, Canadian, French, Polish, and Rumanian airplane designs are represented in the list. *The Aeroplane*, September 8, 1944, page 280, 6 illus.

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Airports and Airfields

Blackpool Airport. Details are given on the Blackpool airport project. The scheme for the proposed British airport comprises a transocean air terminal for landplanes and an adjacent lagoon for flying boats. With the total cost placed at about £30,000,000, it is estimated that when fully developed the airport would cover about 5,000 acres and cater to 50,000 passengers daily. Provision in the triangular layout is made for three main runways: one 5,000 yards long and 200 yards wide, and the other two each 4,000 yards long and 150 yards wide. Subsidiary runways of different lengths run parallel to the three main ones. *Flight*, September 21, 1944, pages 318, 2 illus.

Landing Facilities Development a Key CAA Activity. William A. M. Burden. In a brief article the Assistant Secretary of Commerce discusses some of the work being done by the Civil Aeronautics Administration to promote and facilitate the establishment of postwar civil airports in the United States. In addition to the highlights of a report to Congress containing recommendations for a national airport plan, he tells of the assistance furnished to communities by the C.A.A. on problems of airport management, design of airport buildings, and development of airport plans for metropolitan areas. *Airports*, September, 1944, page 16, 2 illus.

Hemisphere Airports. Norris M. Mumper. Pointing out that despite wartime obstacles scores of airports and landing fields have been constructed in the Americas in recent months, the writer supplies some information about the airport-construction program that is going on in the United States and the 20 other American republics. He also gives some figures on the movement of freight by air and discusses Latin American markets and postwar planes. *Distribution and Warehousing* (*D and W*), October, 1944, pages 76, 77, 122, 124, 125, 2 illus.

New Trends in Aviation Lighting. Wilbur T. Harding. Presented as a paper before a meeting of the Illuminating Engineering Society, this is an investigation of past developments and future trends in airport-lighting systems. The writer first cites the controlling factor of airport-lighting progress as the necessity for safe and regular operations regardless of weather conditions at the terminal airdrome. He next reviews past transition stages from all-way fields with general floodlighting to fields having specific strips or runways, each with its individual lights and, in some instances, floodlights. Indicating existing conceptions that he believes have hampered development, he then offers some pertinent observations regarding boundary lights, floodlights, obstruction lights, and contact lights. General requirements for airport-lighting systems under low-visibility conditions are outlined.

The article includes a report of experiments conducted by the Army and Navy in 1943. The purpose of these experiments was to determine whether lighting units are of assistance in making landings under low-visibility conditions, providing proper approach with radio aids is made. Requirements for typical installations established as a result of the tests are included. In addition, some general conclusions are offered which are based upon service experience with the equipment described.

Some of the writer's predictions with regard to future trends in airport lighting are as follows: Lighting installations will be designed for low-visibility operations and operated at reduced intensities for better weather conditions. More attention will be devoted to the proper application of lighting and radio aids, and the two aids will be properly correlated. Floodlights will disappear. The basic system will incorporate approach and runway lighting using optics that give the desired distribution. Rigid contact lights will be obsolete along with height restrictions. Runway units extending a reasonable height above ground level will be accepted. *Southern Flight*, October, 1944, pages 54–56, 62, 3 illus.

Army's New Washington Terminal May Set Pattern for Nation. A description of the Air Transport Command's terminal facilities at the National Airport Army Base. Intended for the handling of priority passengers, cargo, mail, and personnel wounded in the war, the facilities are reported to include a passenger terminal and operations building; an air freight and mail building; a portable steel hangar measuring 200 ft. square; shops for airplane servicing and maintenance; fueling equipment; an airplane parking ramp covering an area of 50,000 square yards; and an extensive parking area for motor vehicles. The terminal's layout is described as offering a functional approach to the following problems: (1) the expeditious movement of many types of air transport traffic through circulation systems that do not cross, in order to eliminate delays or confusion during peak load periods; (2) proper arrangement of the many administrative and operational activities in the sequence of their business flow; (3) the secondary servicing of passengers and pilots at the proper time and position in the flow of major processing (the general waiting room is the position in the traffic flow where all major circulation systems and secondary servicing join; the passenger ends his secondary servicing here and begins the processing for his flight); (4) flexibility in space layout to permit revision and expansion (this is an important design factor in view of the interdeterminate rate of increase and change in international air traffic, and the complexity of its service requirements). *Airports*, September, 1944, pages 27, 41, 3 illus.

Bases for B-29's Built by Engineer GI's. An account of how bases for Superfortress bombers were built in India by United States Aviation Engineer troops. The general story was obtained through an interview with Major John J. Mattiello, "trouble shooter" on several of the airfields. While most of the work was the extension of runways at existing fields, it was done with little equipment and during the hottest part of the year. *Engineering News-Record*, October 19, 1944, pages 103–105, 3 illus.

Pointers for Hangar Selection. George R. Clay. With small individual hangars suggested as the most feasible type to house personal planes, specifications are described for such a hangar. Requirements are that the cost of the hangar should not exceed $750; that the structure be sufficiently sturdy to withstand heavy snows and winds of hurricane velocity; that it be movable; and that it be large enough to include a workbench, lockers, and adequate storage space for other paraphernalia. Data are also given pertaining to desirable doors, flooring, construction materials, and color schemes for the hangar. Two sizes of hangars are thought sufficient for most personal planes: one with dimensions approximating 40-ft. door span, 9-ft. front vertical clearance, and 25-ft. depth, for planes of under 140 hp.; the other with dimensions approximating 46-ft. door span, 12-ft. front vertical clearance, and 33-ft. depth, for planes of up to 650 hp. *Southern Flight*, October, 1944, pages 44, 3 illus.

Zone Now to Save Airports and Lives. J. J. Hunter. Some observations on the necessity for, and methods of, eliminating obstructions to aerial approaches, by the director of the Review Section, Airports Division, of the C.A.A. Demonstrating the importance of keeping aerial approaches to airports clear, the writer advocates state legislation as the most economical means of affording maximum aerial-approach protection. He reports that this is the principal method contemplated by the Model Airport Zoning Act, recommended by the C.A.A. However, as set forth in the model act, the zoning would be used in conjunction with, and supplemented by, navigation assistance and the acquisition of property. An interpretation of what is meant by airport zoning is included in the article. *Airports*, September, 1944, pages 30, 42, 43, 1 illus.

Some Advantages of State Control of Airport Maintenance. Dexter C. Martin. From his experience as Director of the South Carolina Aeronautics Commission, the writer tells why he believes that airport maintenance should be the responsibility of the state, rather than the Federal Government, the municipal government, or private operators. His arguments are based on the reasoning that airports constitute a public utility "system" and not a series of disjointed operations. The writer also considers the questions of how funds

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should be raised to provide for airport maintenance and methods by which the maintenance should be done. He advocates the taxing of gasoline and a Federal subsidy among other means of obtaining revenue. Regarding equipment, he suggests the use of mobile maintenance units that can be rotated among the airports. *Aero Digest*, October 15, 1944, pages 54, 55, 2 illus.

Clearing the Runways. Col. R. C. Kuldell. Some brief remarks are made on the maintenance tasks performed by the Army Service Forces' Post Engineers. A large part of the article is devoted to the subject of snow removal from airfield runways. Experiments with snow-removal equipment are described, and information is supplied regarding the methods used for snow removal. *Aviation Maintenance*, October, 1944, pages 60–64, 176, 178, 6 illus.

'Airport Lighting Equipment Vital.' E. J. Foley. The writer discusses the work of the Industry Advisory Committee on Aviation Ground Lighting Equipment. Consideration is given to four types of equipment: "homing" devices, hazard-marking lights, wind-direction indicators, and landing-direction indicators. *American Aviation*, October 15, 1944, page 74.

Batching Concrete for B-29 Bases. Capt. H. E. M. Stevenson. A short description is given of a concrete mixing plant improvised for the construction of a Superfortress air base in India. *Engineering News-Record*, October 19, 1944, pages 105, 106, 2 illus.

Merchandising Essential to Successful Airports. Ed Nilson. The value of a well-"merchandised" airport to a community is indicated in the record of one unnamed town. It is reported that in a year and a half this town realized intangible revenues of over $200,000 from private air travel. Mentioning the auxiliary services that help to make an airport a busy and successful one, the writer offers some advice to smaller communities on the establishment of facilities for private aircraft. The fixed-base operator-manager plan of airport operation is considered the more desirable for small cities during the first five years of the airport's existence. For purposes of promoting the airport and assisting its manager, the formation of an "Aviation Progress Club" by community leaders is recommended. *Airports*, September, 1944, pages 22, 41, 1 illus.

Airport Turf Maintenance Pays Dividends. J. R. Yarrow. The writer discusses the important points in connection with airport turf maintenance. Emphasis is placed on the high cost of turf neglect. How it is possible to eliminate many repair expenditures by forethought, organization, and an understanding of the importance of turf cover is described. *Aviation Maintenance*, October, 1944, pages 74, 75, 122, 130, 134, 136, 138, 9 illus.

Professional Training for Airport Managers. John H. Frederick. Airport management is demonstrated to be a professional job requiring trained, experienced personnel. It is suggested that, while part of the educational work for training airport managers can be accomplished by universities, supplementary practical knowledge should be gained by working under the guidance of experienced managers. The practice of considering a pilot's license a qualification for airport operation is criticized. While it is admitted that it is well for an airport manager to be a flier, it is stated that it is more important that he be a good business man. *Southern Flight*, October, 1944, page 43.

Who'll Operate Our Municipal Airports? William D. Strohmeier. Three alternatives are described as the answer to the problem of how operating rights should be granted on municipal airports. One is to make the airport the "Main Street" of the air and let anyone operate. The second is to limit the competition to a small number of moderately well-financed operators. The third is to turn over the hangar and complete business of running the airport to one concern. Advantages and disadvantages of each scheme are considered. The conclusion is that each municipality must choose for itself the system that will provide it with satisfactory answers to the following basic question: Will the operator or operators guarantee complete and satisfactory service to transient and local owners, safe and thorough flight instruction, adequate plane storage and maintenance, and responsible management? *Air Facts*, November, 1944, pages 74–80.

Armament

How Good Is Our Ack-Ack? James L. H. Peck. While this article is principally a survey of American antiaircraft weapons, it also contains some notes about antiaircraft artillery used by the British, Russians, and Germans. Descriptions are given of antiaircraft automatic weapons and heavy guns employed by the U.S. Army and Navy. Functions and types of fire-control devices and sound locators are explained. Other information is offered pertinent to training and organization of U.S. Army and antiaircraft personnel, rocket antiaircraft weapons, and the use of searchlights and barrage balloons in antiaircraft operations. For the latter phases of the war in the Pacific it is predicted that the employment of antiaircraft rocket devices will become more general on land and sea and that the smaller automatic weapons will have robot directors. *Flying Aces*, November, 1944, pages 43, 44, 49, 50, 62, 63, 8 illus.

Avigation

An Outline of Practical Radio Navigation. Practical radio navigation of the present day is discussed. In addition to an interpretation of the principles of radio navigation and their application, this article contains an indication of the science's limitations and advice about how to avoid some of the errors commonly encountered in radio navigation work. Three different phases of radio navigation are considered: navigation by radio ranges and ultra-high-frequency markers of all categories; navigation using the direction-finding loop; and navigation aids that are controlled from the ground. *Aero Digest*, October 15, 1944, pages 80, 81, 146, 2 illus.

Avroguide. Capt. Burr Leyson. An avigational system, designed particularly for private fliers, is suggested. As described, this system consists basically of a network of automatic transmitters sending vocal identifications and guiding messages of 90-sec. duration. Different wave lengths are used by the transmitter in the various zones. All transmitters are of low power and have a relatively short sending range. Bearings are taken by means of a loop antenna to determine positions, while large neon arrows mounted on the transmitters serve as auxiliary guides. Control is centralized in each area.

The operation of the suggested system is indicated by an account of a hypothetical flight. It is claimed that with the Avroguide plan a pilot would know at all times his position; the location of the nearest airport or landing strip; immediate, as well as future weather conditions; and all other data pertinent to the safety of his flight; and all that would be necessary for cross-country trips would be maps of the territory to be flown over and the ability to read them. With moderate production the cost of a receiver and loops for the average private plane is estimated at less than $50. Furthermore, it is stated that the network of transmitters can be self-sustaining or even revenue-producing by selling advertising time to commercial sponsors. *Skyways*, November, 1944, pages 53, 96, 102, 4 illus.

Business and Finance

Don't Put a Boy on Man-Sized Terminations. Raymond L. Hoadley. In passing along some advice to airplane manufacturers on how to avoid confusion in contract terminations by immediate preparation of well-planned termination procedures, the writer stresses the importance of having adequately manned staffs, headed by key personnel, to handle the work. Four recommendations made by Colonel Rawlings of the A.A.F. Air Technical Service Command's Readjustment Division are outlined: (1) Every company should get its record into agreement with physical inventories and have its physical inventory put on a cost basis; (2) commitments for materials and subcontract items should be adjusted; (3) a separate termination organization with trained personnel should be set up; and (4) problems that will appear on termination should be predetermined.

From Colonel Pillsbury, Chief of the Termination Section of the Command, five recommendations for speeding up termination are reported: (1) Set up a termination organization that includes key personnel, headed by a director of

terminations and including competent accountants of the executive type; (2) make sure that termination personnel know thoroughly all the rules and regulations; (3) divide the problem into two parts—cases currently pending and plans for the coming day of mass termination; (4) in the case of large companies, decentralize authority to the plants and divisions, as the Government is doing; and (5) try to get along under the rules and do not seek "some different way" to solve the problem. *Aviation*, October, 1944, pages 208, 306, 308, 309, 1 illus.

Civil Aviation

Making Flying Attractive to the Public. Bernard Thyson. A commentary in which an American pilot discusses the subject of making flying more attractive. It is stated that regulations covering the obtaining of private licenses should be simplified. Emphasis is placed on the importance of improving safety factors and other conditions in order to make flying easier for the public. The building of more air strips is recommended. The promotion of aviation in Canada is discussed. *Aviation Review*, September, 1944, pages 15, 31.

Pattern for Progress. Features of the conversion program by which Southeastern Air Services, Inc., is expanding facilities for service to private fliers are outlined. The program is built around a system of company and associate bases that will offer different phases of aviation service, including flight instruction; airplane sales, financing, and insurance; maintenance, overhaul, and storage; charter flights; mapping and aerial photography; crop dusting and related agricultural air assistance. A company base functioning at Athens, Ga., and two associate bases operating in South Carolina form the nucleus of the base plan.

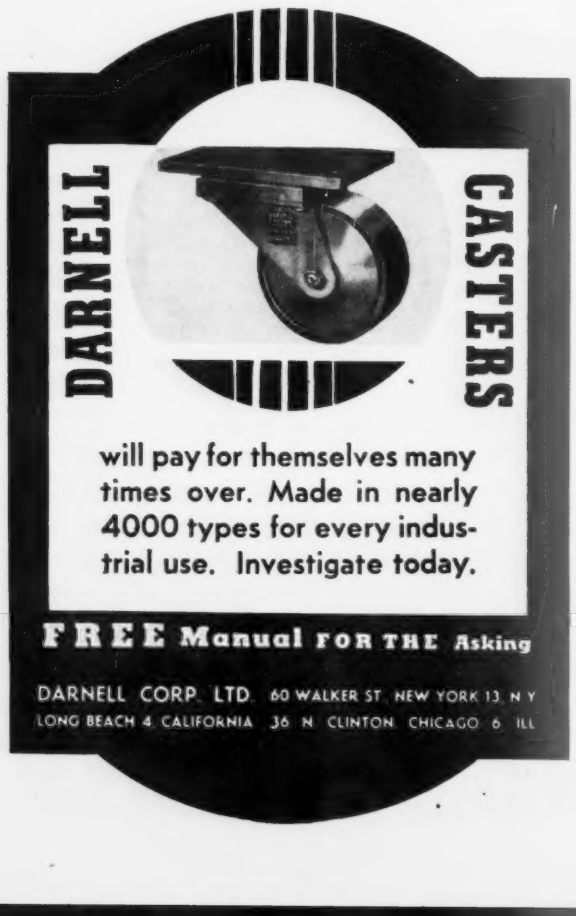
Operating methods of the associated bases are explained. The company's participation in feeder-line air transport, through a subsidiary company, is noted. It is reported that the policy is to avoid undue emphasis on this phase of activity in case the proposed routes be delayed or curtailed. *Southern Flight*, October, 1944, pages 34, 35, 70, 4 illus.

Look Before You Buy a War Surplus Airplane. Robert C. Blatt. Information is given about the conditions under which war-surplus airplanes are being sold and how to examine such planes for defects. A table shows the parts that should be checked and the defects to look for. It refers to the propeller, engine, landing gear, wings, tail assembly, and fuselage. It is also pointed out that prospective purchasers should check with the Civil Aeronautics Administration or the sales representatives at the base regarding the possibility of any operational restrictions being applicable to particular airplanes which might affect their choice. The writer notes that military planes may have to be certificated with operational restrictions—particularly restrictions against acrobatics and intentional spins, etc. A list of the addresses of the centers where surplus airplanes will be sold is given at the end of the article. *Aviation Maintenance*, October, 1944, pages 46, 47, 178, 180, 182, 184.

Control Equipment

Valve Follower Mechanisms for Servo Controls. A brief article classifies basic types of mechanical valve follower mechanisms as: (1) screw and nut, (2) wedges, (3) floating levers, (4) epicyclic gearing, (5) flexible cord and pulleys. Drawings, accompanied by explanatory captions, depict the various types. *Product Engineering*, October, 1944, pages 702, 703, 8 illus.

Remotely-Operated Controls for Aircraft Hydraulic Systems. Ralph E. Middleton. This article deals with control mechanism used to direct the fluid to the proper part of the hydraulic system as required by the operator. The writer discusses four-way selector control valves of the series and parallel types, auxiliary four-way control valves, and the use of electricity for the remote-control operation. The relative merits of the different basic systems are examined. It is stated that the combined use of electric and hydraulic power represents the best approach to the problem. Various developments in this type of control system are described. *Automotive and Aviation Industries*,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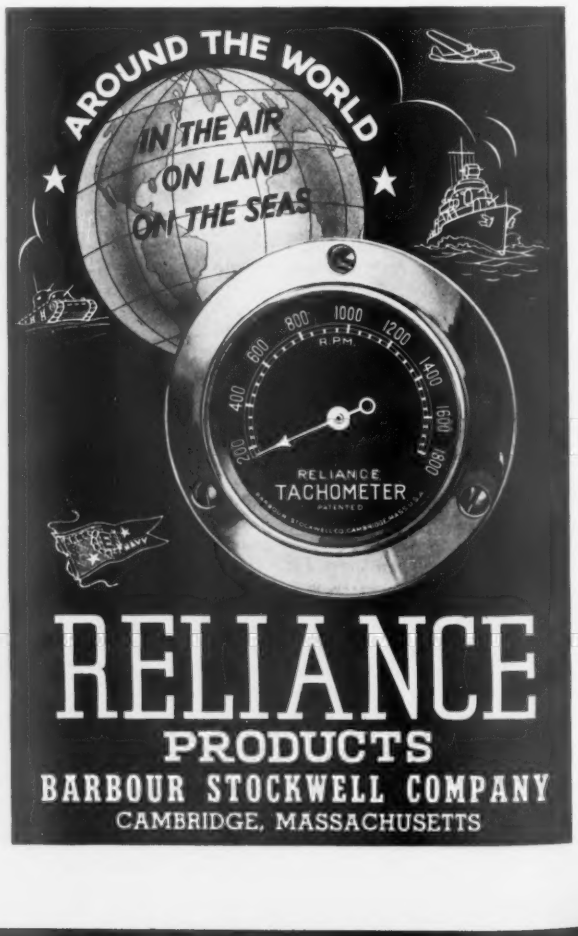

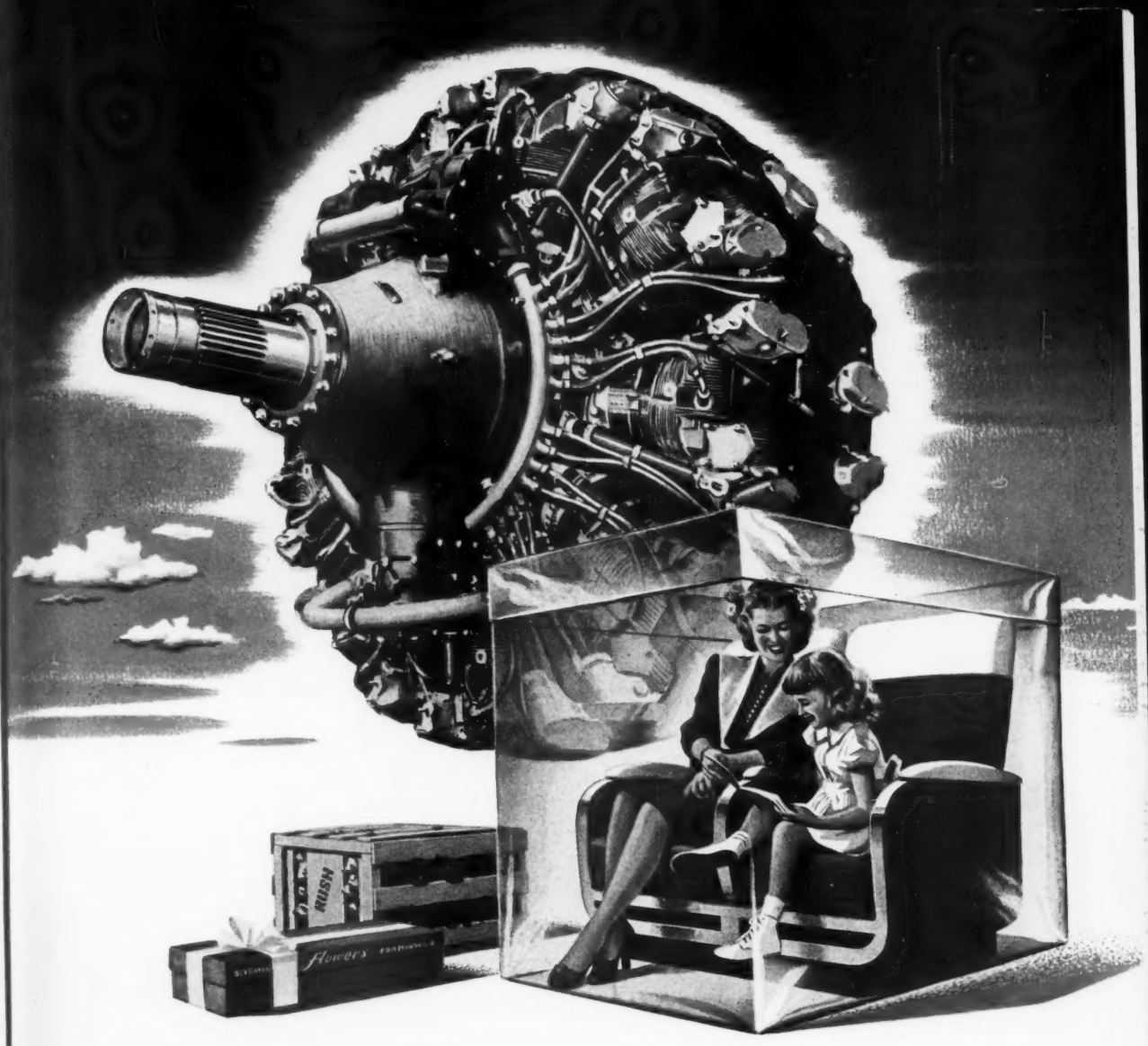

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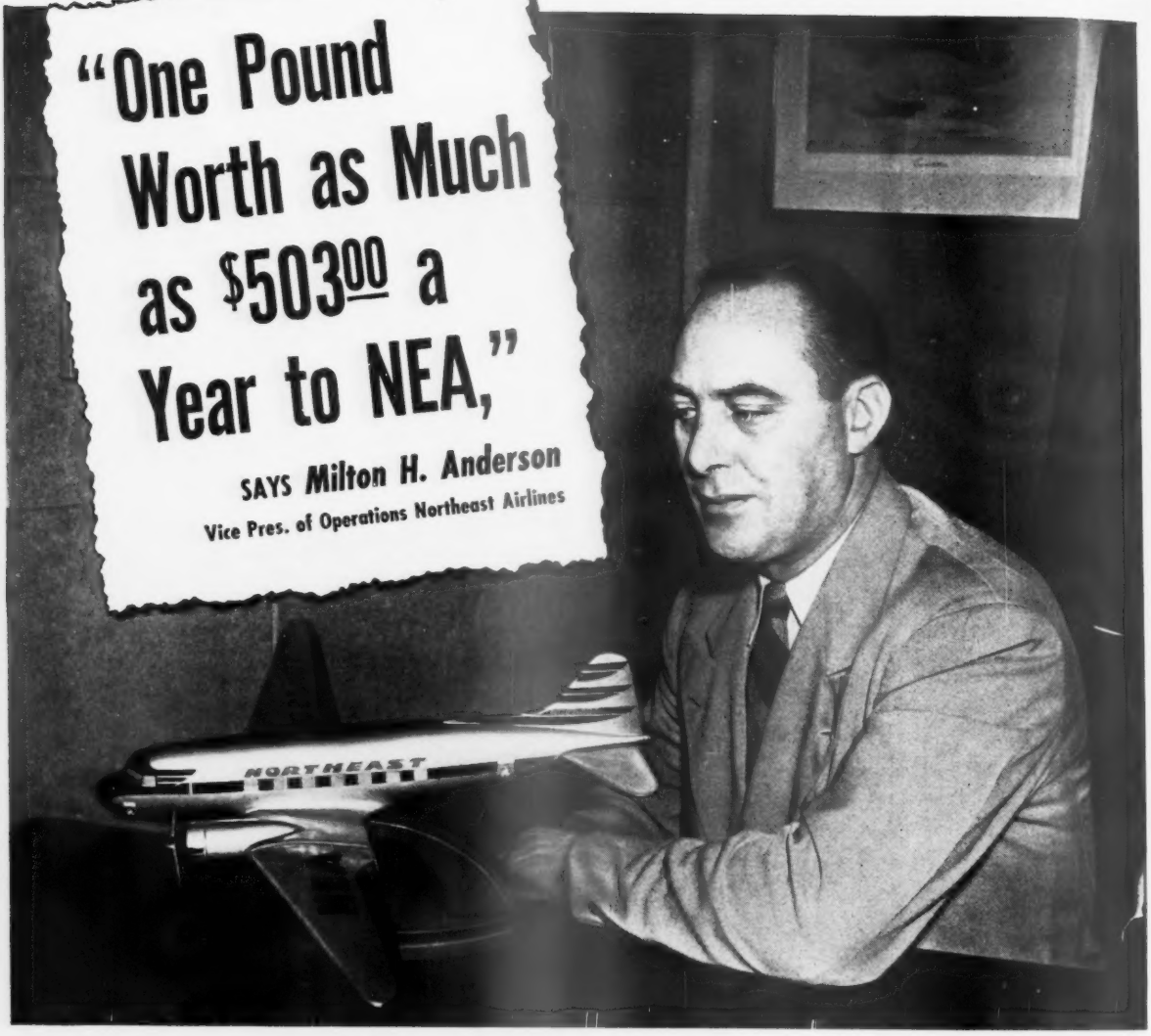

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METAL-TO-METAL contacts cause SHOCK . . VIBRATION . . NOISE . . WEAR . . DESTRUCTION!
RUBBER
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RUBBER-TO-RUBBER contacts ABSORB shock . . . MINIMIZE vibration . . . MUFFLE noise . . . PROLONG LIFE of moving parts!
Cut-away view of threshing mechanism in a modern combine. Rubber faced steel cylinder bars, operating in connection with a rubber stripping plate, and two stationary block rubber concaves, protect hard and soft shell crops from damage.

SHOCK is the foe of machinery. SHOCK and resultant VIBRATION caused by metal-to-metal contacts of moving parts are fast being eliminated by modern processes of rubber-to-metal adhesion.

A "striking example" of metal-to-metal *versus* rubber-to-rubber contacts is the development of the modern combine or "all-crop harvester."

ORCO engineers, working closely with farm machinery engineers, applied modern rubber adhesion processes to eliminate metal-to-metal contacts in threshing mechanisms.

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October 15, 1944, pages 22, 23, 88, 90, 92, 5 illus.

Basic Principles of Power Boost Flight Controls. E. G. Riley. In opening this discussion of power-boost flight controls for large aircraft, the writer describes various substitutes for power boost which have been tried. It is stated that all of these have disadvantages that prevent their use on large aircraft. The requirements for a successful power-boost system then are outlined. Consideration is given to the location of the major elements, and the conditions requiring boost control are listed and discussed. The boost system used on the Martin Mars is described in sections dealing with the elevator control system, the pressure source, safety features, and the automatic bypass valve. *Industrial Aviation*, October, 1944, pages 7–9, 94, 95, 4 illus.

Deicing

The New T.K.S. Airframe De-icing System. The principles, operation, and equipment of a British airfoil-deicing system are detailed. Called the T.K.S. system, this is based upon the use of chemical deicing fluid capable of mechanical distribution. Essentially, the system consists of a motor-driven, positive-displacement, multioutlet pump, a deicing fluid filter, a motor controller, deicing liquid, and special metal leading-edge distributors. The deicing fluid is supplied from a suitable storage reservoir to the pump via the filter, each individual pump outlet being piped to one or more of the special metal distributors inset in the leading edges of the wings, tail plane, and fins. The individual pump outlets are calibrated to distribute the correct quantity to the surface served. The liquid is carried by the air stream over all surfaces of the wings, tail planes, fins, and controls, thereby protecting all essential components. Two rates of flow are provided for the deicing liquid—one for normal, and the other for emergency use.

Description of this system is preceded by some general notes on three different methods of airfoil deicing: the "boot" method, the hot-wing process, and the use of chemical deicing paste. *The Aeroplane*, September 29, 1944, pages 359–361, 4 illus.

Design

Progress in Aircraft Design. Bruce Smith. It is noted that the progress in aircraft design during the past 40 years has been steadily upward, as measured by an arbitrary computation of efficiency chosen to bring out the salient points in connection with aerodynamic characteristics. Several simple approaches are given to illustrate the progress made.

A concrete example is given of airplane design improvement by comparing an accepted 1919 design with a hypothetical airplane of the present, both having the same gross weight, span, power, and landing speed. Among the betterments expected in the future are: improved aerodynamic characteristics at high speeds through increased wing critical speed from a compressibility standpoint; incorporation of variable-area means in the tail surfaces; and increase of extensible wing area. Factors other than aerodynamic improvement that have contributed to the higher efficiency are summarized. *Aero Digest*, October 1, 1944, pages 58–60, 5 illus.

"Golden Hind" Goes East. An account of how a Short Empire flying boat of the "G" class, originally intended for civil flying but converted to military use, was reconverted into a civil transport. It is reported that the changing of seating capacity from 40 passengers to 38, the obtaining of a high degree of comfort, and the considerable reduction of the noise level in the cabins entailed an additional weight of about 550 lbs. Two innovations were incorporated: one, a concealed escape hatch working on a press-button system; the other, the fitting of panels to house the "defence" and black-out curtains. Because of the hull primary structure, the passenger accommodation was divided into four compartments, larger than those on the peacetime Empire flying boats but similar in general layout. Extensive use of fabric instead of panels is credited with having saved weight and having been effective for soundproofing. *Flight*, September 21, 1944, pages 315, 317, 2 illus.

Design Engineers Want More Information in Catalogs. E. A. Pinger. The need for improvement in the cataloguing of equipment and hardware articles for aircraft is emphasized. Recommendations contained in a study made by the National Aircraft Standards Committee are given. Advantages of good catalogue files containing specific technical information, proper indexing, and minimum requirements are also discussed. *Product Engineering*, October, 1944, pages 679, 680.

Favoring the Classical in Flying Boat Hydrostatics. W. J. Griffey. Methods of investigating the static water characteristics of a proposed flying-boat hull design are discussed. A comparison is made between the classical methods of naval architecture, modified to suit the requirements of flying-boat design, and the experimental method, involving the building of a scale model. Favoring the classical method, the writer explains the basic principles and steps in making these calculations for determining the draft and trim of the hull when afloat. He gives detailed instructions for determining the normal load water line for a typical flying boat, applying mathematical formulas for calculating the center of gravity, the center of buoyancy, the displacement, the trim angle, and other relationships. Other computations are carried out to show the change of trim caused by the movement of the center of gravity, the transverse stability of the hull, and the determination of metacentric height. Allowances for fuel tanks, and the displacement of side floats also are explained. *Aviation*, October, 1944, pages 159–163, 8 illus.

Pilot's Prescription. Part I. Capt. W. Laing Stewart. The first of a series of articles presenting an air-line pilot's views regarding the development of British intercontinental transport aircraft for the postwar period. In this first article, the writer compares the advantages of air-cooled engines with those of the liquid-cooled type. While indicating why the former have been favored in the past, he shows a preference for the latter type because of its adaptability to tandem mounting, which, he suggests, would be useful in future civil air transports. He advocates employing eight engines mounted in four tandem pairs, in the belief that this type of design would solve stress problems and facilitate lighter construction.

Part I also initiates a consideration of the influence of available runways upon the design of future airplanes. Rather than design the planes to conform with existing runway facilities, the writer intimates that longer runways should be built which could accommodate larger, higher powered landplanes. *The Aeroplane*, September 1, 1944, pages 244, 245.

Pilot's Prescription. Part II. Capt. W. Laing Stewart. This second article of a series gives the writer's opinion as to the deficiencies and merits of British airplane-design development. He also lists the minimum specifications of two types of long-range commercial aircraft which he believes would stand a good chance of competing with the designs of other nations after the war is over. Both are landplanes—one with a maximum weight of 120,000 lbs. and a range of 2,610 miles; the other with a maximum weight of 150,000 lbs. and a range of 3,045 miles. *The Aeroplane*, September 8, 1944, pages 272, 273.

Pilot's Prescription. Part III. Capt. W. Laing Stewart. The third of a series of articles in which an air-line pilot suggests design standards for British postwar civil air transports. Part III contains his comments regarding the design of cockpits or flight decks for large transport planes. He specifies that, in addition to the equipment normally installed at present, a deck for a crew of five should comprise a minimum of five small wardrobes, five lockers, food and drink locker, cabinets for files, logbooks, books of tables, sextants, chronometers, etc., and a lavatory with wash basin. The size of the deck, he believes, should be at least double the area now normally allotted to it. As laid out originally for Pan-American Airways, the Boeing 314 Clipper flying boat is cited as the only airplane known to the writer that at present provides

This advertisement is one of a series which is appearing in national magazines and newspapers as Consolidated Vultee's contribution toward a clearer public understanding of transportation's role in the war, and its postwar opportunities and responsibilities.

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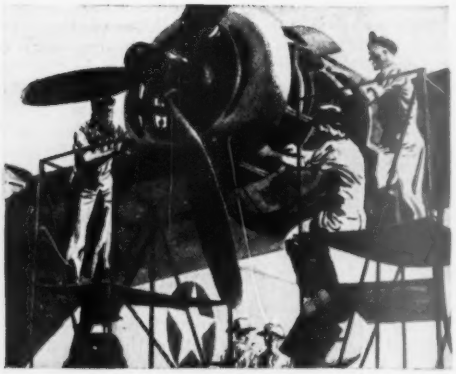
in 95 hours and 20 minutes!



1. 12:00 midnight Sunday: A huge Liberator Express, loaded with a secret cargo, roars down its California runway and soon dwindles to a speck on the horizon. The dispatcher checks off another routine flight for CONSAIRWAY, the military airline established in 1942 by Consolidated for the Air Transport Command.

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5. Born of war, CONSAIRWAY's job, in the beginning, was to bring back Ferry pilots who had delivered bombers to the South Pacific. Westbound cargoes, today as then, consist of tons of spare aircraft engines and parts, medical supplies, and ammunition—in short, *any* supplies that are *needed fast* by our fighting men "Down Under."

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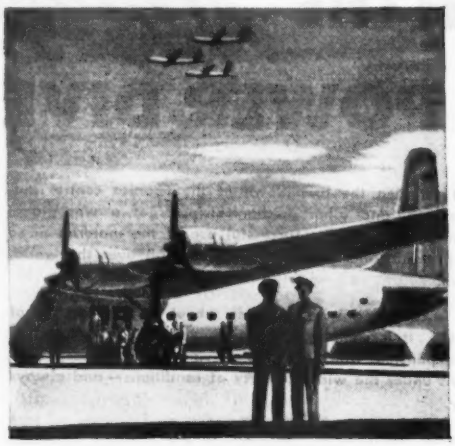

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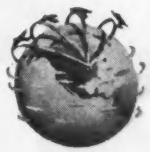

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Life Saver—Probably one of the smallest warplanes in use, the famous Consolidated Vultee "Flying Jeep" has added a new job to its many other uses. Modified as a flying ambulance (*capacity: 1 litter*) it is speeding wounded men to base hospitals from small jungle clearings and other inaccessible spots.

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adequate space for its flight crew. *The Aeroplane*, September 15, 1944, page 302, 1 illus.

Structural Details of the Douglas C-54. A design analysis of the Douglas C-54. Sectional drawings of various components illustrate details of this transport plane's design and construction. The C-54 (or DC-4) is described as a four-engined, all-metal, low-wing monoplane of semimonocoque construction. Its overall length is given as 93 ft., 5 in.; its wing span, 117 ft., 6 in.; total wing area, 1,462 sq.ft.; the area of the ailerons, aft of the hinge line and including the tab, 93.7 sq.ft. The four Pratt & Whitney R-2000 engines are rated at 1,450 hp. each for take-off. Maximum speed is reported to be 280 m.p.h. at 23,200 ft., and it has a gross weight of 56,200 lbs. *Aero Digest*, October 15, 1944, pages 82–84, 86, 88, 12 illus.

Pre-Production Technique. J. N. Earl. This is an article on the lofting practices and template reproduction techniques of Westland Aircraft Ltd. It explains the function of a mold loft in the establishment of accurate data for use in the initial production stages of a new design. It also describes in detail the laying out of a mold loft, its application in the production of full-size drawings that give the basic geometry of the complete aircraft, and its relation to other design and production departments. The direct-contact process by which the company obtains reproductions from a master template through the medium of printing ink are reviewed briefly. *Aircraft Production*, October, 1944, pages 484–490, 16 illus.

Ace in the Hole. Leighton Collins. Suggestions are offered on how to improve the fuel systems of personal airplanes. Three problems are considered: (1) fuel systems so designed that in service they might cause trouble because they are too infrequently and too inconveniently flushed; (2) carburetor ice; and (3) uncertain gasoline reserves. As the solution to the first problem, it is suggested that there be installed on the instrument panel three controls operating petcocks. The petcocks would be attached to lengths of copper tubing through which the gasoline would be drained onto the ground a safe distance away from the exhaust pipe. For the second problem, three alternatives are prescribed: an automatic carburetor preheat control; a fuel injector system; or a scheme of heating by conduction the metal parts of the carburetor on which the ice accumulates. A reserve tank that would provide 30 min. of flying is recommended for combating the third problem. This tank would fill automatically when the main tank was more than two-thirds full. *Air Facts*, November, 1944, pages 44–50, 1 illus.

Design Analysis of the Lockheed PV-1 "Ventura." Wilfred N. Wallace. An analysis is given of the design features of the PV-1 Ventura. After an outline of the diversified services for which the plane is used, an engineering description is given of the materials and structural features of each of the main parts of the airplane. Detailed design information is supplied about the wing group, controls, fuselage, empennage, landing gear, power plant, engine cowling, and the exhaust, oil, and fuel systems. Illustrations include an exploded view of the plane, a large picture showing its internal construction, and various drawings of component parts. *Industrial Aviation*, October, 1944, pages 17, 18, 20–22, 24–31, 98–100, 16 illus.

Fluid War Design. A group of photographs illustrates the transition of several American military planes from their original designs to their most modern versions. Comparative photographs are shown of the North American B-25 Mitchell, Consolidated Vultee B-24 Liberator, Boeing B-17 Flying Fortress, Curtiss-Wright C-46 Commando, Curtiss P-40 Warhawk, Lockheed P-38 Lightning, North American P-51 Mustang, Republic P-47 Thunderbolt, Bell P-39 Airacobra (P-63 Kingcobra). *Western Flying*, October, 1944, pages 146, 148, 18 illus.

The Focke-Wulf 190. John Foster, Jr., and Chester S. Ricker. Number nine in a series of design analyses, this is a comprehensive engineering report on the Focke-Wulf 190. Details of the German fighter plane's design and construction are illustrated by numerous sectional drawings. Specifications and design data are listed. It is stated that the principal theory underlying the development of this plane appears to be the reduction of field maintenance time. *Aviation*, October, 1944, pages 127–152, 47 illus.

Make Flying Easier. Edward E. Slattery, Jr. Elimination of steering by foot controls is urged as the first step toward simplifying aircraft operation. Noting the value of simplified operation to the development and promotion of aviation, the writer demonstrates the feasibility of design changes enabling such elimination of the foot pedals. He cites the Ercoupe and Skyfarer as airplanes that have incorporated such changes, and he refutes criticisms of the principles by which the controls of these planes have been simplified. *Flying*, November, 1944, pages 30, 31, 118, 134, 3 illus.

Electrical Equipment

Some Aspects of the Application of Induction Motors to Aircraft. H. J. Braun. The fundamental characteristics of the three-phase induction motor are examined from the point of view of their possible application to aircraft. A brief review of present motor specifications is supplied, and test data are given on the operation of an induction motor with one or two lines cut as though they had been shot away in aerial combat. Common types of motor loading are discussed with reference to the suitability of induction-motor drive for each. Curves are presented to illustrate the characteristics of motors and various types of loading. *Electrical Engineering*, October, 1944, pages 769–772 (Transactions), 11 illus.

Effect of Current Aircraft Electrical Developments on Post-War Design. Lt. Col. T. B. Holliday. The writer reviews the progress made in electrical equipment for aircraft during the war and discusses the possibilities for peacetime applications opened by these developments. Information is given regarding the progress made in generator design, voltage regulation, motor design, and the design of other electrical equipment. The possibilities of 400-cycle power, which, it is stated, have only begun to be realized, are discussed. *Industrial Aviation*, October, 1944, pages 44, 46, 48, 49, 103, 104, 4 illus.

Gaseous-Discharge Lamps for Airplane Lighting Service. E. W. Beggs. Consideration is given to the advantages of fluorescent lamps for aircraft, with particular reference to 400-cycle operation, which has been found to provide about 20 per cent greater efficiency than the 60-cycle alternating current for which these lamps were created originally. Information is given regarding an investigation conducted to determine the performance of the fluorescent lamp throughout the normal and anticipated range of ambient temperatures and at extremes of low temperature that may be encountered at high altitudes. The experiments indicated that satisfactory light output, high efficiency of light production, and dependable operation of fluorescent lamps are readily obtainable on 400-cycle airplane circuits. The results of a study of the effect of low temperature and 400-cycle operation on two types of glow lamps are also given. The study indicated that glow lamps are practically unaffected by low ambient temperatures and their performance is excellent at 400 cycles. *Electrical Engineering*, October, 1944, pages 760–763 (Transactions), 11 illus.

Aircraft Electric Systems. Part I. R. J. Sutton and G. C. Close. Beginning a series about electrical systems for modern aircraft, the writers note the increasing demands for electric power. They trace the development of generators from the low-power units, designed to supply ignition current only for early airplanes, to the present electric power-generation and distribution systems for a four-engined bomber, delivering 24,000 watts and requiring 10 miles of wiring. After classifying power demands into four general categories—for heating, lighting, mechanical power, and communications—they give consideration to the mechanical, electrical, and thermal problems involved in the application of electric power to aircraft. Among the limitations that designers have been called upon to overcome are those of space and weight, vibration, temperature ranges, and atmospheric density. The effects of these limitations are discussed, and steps taken to overcome them are explained.

In addition to generators, the first article of the series describes the functions of electrical auxiliaries such as voltage regulators, relays, and storage batteries. The various types of these devices are explained, with information about the conditions under which

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each operates and the advantages and disadvantages of each. Apparatus operating on direct current is compared with alternating-current devices with respect to performance, weight, cost, and maintenance. The latter part of the article outlines the benefits and difficulties of independent auxiliary engines as a source of electric power, compared with wind-driven and main engine-driven generators, and indicates that the present trend is toward the use of auxiliary engines in the larger types of airplanes. *Western Flying*, October, 1944, pages 88, 90, 92, 94, 6 illus.

Dimensional Studies of Lightweight Motors for Aircraft. Wayne G. Morrill. The writer points out how relatively complicated machines may be compared by a method similar to dimensional analysis for the purpose of establishing such relationships as output per pound or output per cubic inch. The effect of size on design properties is discussed. The properties of lightweight motors for aircraft are analyzed. Consideration is given to the basis for direct-current aircraft-motor study. *Electrical Engineering*, October, 1944, pages 698–701 (Transactions), 4 illus.

Engines

Mechanical Failures in Aero-Engines. W. N. Twelvetrees and K. W. Walpole. Typical design and production weaknesses in aircraft engines revealed by wartime operation are described. It is noted that the principal difficulty in the investigation of an engine failure is the complexity that results from secondary failures and the fact that similar effects can be produced from more than one cause. Basic factors that may be regarded as the most general cause of wartime engine failure are listed in the order of average occurence: (1) operational overloading and abuse; (2) "shock loading"; (3) enemy action; (4) "hydraulicing"; (5) defects in design; and (6) defects in material.

It is explained that "shock loading" occurs when the propeller strikes some fixed object and "hydraulicing" is a word used to describe the results of hydraulic pressure in the combustion chamber caused by a collection of oil or gasoline or both. Various kinds of defects and types of engine failures are described. Charts show the general relationship of the major causes of engine failure, and the relation of cause and effect in a typical complex failure. Micrographs and photographs reveal the defects in parts. *Aircraft Engineering*, September, 1944, pages 268–274, 18 illus.

Recent Research in Poppet Valve Train Design. Carl Voorhies. This article contains data on valve-train design derived from recent research projects. The usual problem confronting the engineer is the designing of a valve train that will provide as much power as possible with the torque curve required for the particular application, will have parts that are durable, and will maintain quietness of operation to a degree consistent with the application of the engine. Valve-train design by the trial-and-error method is discussed, and consideration is given to faulty motion, the major cause of which is stated to be excessive deflection. Methods of studying valve-train operation are given.

Four classes of instruments for studying the valve train are listed as: (1) equipment that measures the lift of the valve at selected positions of the cam so that the path of the valves in motion may be plotted; (2) oscillograph equipment that produces a picture of the lift curve, velocity, and acceleration curve; (3) a strain gauge that produces a graph indicating the loads on a selected part throughout the cycle, when used with an oscillograph; and (4) high-speed motion pictures. The use of the stroborometer for obtaining valve-motion curves is described. Consideration is given to cam design, theoretical and actual cam stresses, rocker-arm design, and the advantages of the hydraulic valve lifter, especially for air-cooled engines. *Automotive and Aviation Industries*, October 1, 1944, pages 92, 94, 96, 14 illus.

Civil Aircraft Engines. C. A. H. Pollitt. Criticizing the comments offered in a preceding article regarding the advantages of air-cooled engines for civilian aircraft, the writer takes up the case for liquid-cooled engines. He discusses the merits of this type of engine for high-powered civil air transports, particularly citing its adaptibility for "buried" installations. While questions of compactness and accessibility are also considered, weight advantage is another factor that is stressed. A comparative weight analysis between an air-cooled and a liquid-cooled power plant in chart form is used to define the superiorities of the latter on this point. *Flight*, August 31, 1944, pages 240, 241, 3 illus.

Engines for Private Planes. Carl T. Doman. In a survey of the powerplant requirements of postwar personal airplanes, the writer states that a fundamental need is the standardization of engine design and performance so that quantity production and reduced costs can be achieved. The problems of adapting aircraft-engine design to the quantity-production methods of the automotive-engine builders are outlined. Among the features believed to be imperative for engines for personal aircraft are means for preventing carburetor icing, dual ignition by either magnetos or batteries, and means for starting the engine without turning the propeller by hand. Costs are analyzed on the basis of a projected two-passenger plane to be sold, completely equipped for about $1,200, which would allow about $300 for the engine. Accessories such as a starter, generator, magneto or distributor, spark plugs, wiring, and carburetor could be of modified automotive type, costing about $30.

With a production rate of 100 engines per day, it is considered possible that a production cost of $100 for labor and material could be attained for a 100-hp. engine, but the desired weight limit of 100 lbs. is not believed to be feasible in the immediate future, it being more likely that the minimum will be around 200 lbs. Performance figures are given for engines ranging from 90 to 185 hp., with different propellers, comparisons are made between direct-driven and geared propellers, and a market is suggested for manufacturers of automotive transmissions through supplying standardized reduction-gear units for personal airplanes. Higher engine speeds are predicted, and different cylinder arrangements, using from four to twelve cylinders, are discussed. Other matters considered are fuels and cooling. The special problems involved in engines for helicopters are outlined. *Flying*, November, 1944, pages 51, 52, 106, 110, 3 illus.

Model Maintenance Plant. Canadian Wright Ltd.'s production-line techniques of engine overhaul are reviewed. Routines outlined include those of disassembly, cleaning, inspection and checking, replacement of worn parts, painting, and metallizing, reassembly, testing, and preparation for shipping. Information is also offered regarding the layout of the plant and the tools, jigs, and fixtures employed for the engine-overhaul procedures. *Canadian Aviation*, October, 1944, pages 139, 140, 143, 144, 146, 157, 13 illus.

The Gipsyqueen II. Part I. J. A. Oates. First of a series reviewing the methods employed for the manufacture of the de Havilland Gipsyqueen II. Part I contains a study of the engine's design features and an account of the machining operations that are performed on the crankcase, cylinder barrel, and head. Design and construction details are given on the cylinders, pistons, crankshaft, crankcase, camshaft, lubrication system, ignition, induction system, and starting equipment. The operations described include those of drilling, rough-boring, facing of the bearings, finish-boring, boring of the shells, and thread-grinding. In addition to particulars about the equipment used in these procedures, the article also offers a series of photographs and sectional drawings in illustration of the details discussed. *Aircraft Production*, October, 1944, pages 460–472, 31 illus.

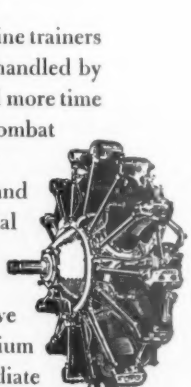
Device Indicates Powerplant Faults. Thomas A. Dickinson. A warning device for indicating the incipient failure of an aircraft engine is discussed in this article. Developed by the Consolidated Vultee Aircraft Corporation, this instrument is described as a deflection-indicating electrical limit switch that

"Until perpetual motion is here, gimme the Jacobs," says T/Sgt. Jinks. "I tended teakettles in this man's Army when they thought the JN-4 was a hot plane. I remember jobs that needed two hours in the shop for every one in the air. An' I'm here to tell you that this baby has fewer headaches and less hard work in it than any plane engine I ever met! You grease monkeys get a break because this outfit has Jacobs, and I want you to treat 'em right respectful—see?"

Technical Sergeant Jinks has almost as many hash marks as stripes and rockers on his sleeve. And when it comes to rating aircraft engines, his opinion is as good as they come.

Ground crews in training squadrons are powerfully partisan to the Jacobs. Three years ago, regulations specified 350 flight hours as the maximum service period between major overhauls. That period has been gradually extended to 1200 flight hours! And the Jacobs rarely leaves its nacelle between majors.

YET these Jacobs in the twin-engine trainers that school the bomber pilots, are handled by students, make more take-offs, spend more time at full throttle than any engine in combat service—or commercial operation!



This record of the Jacobs will stand the closest scrutiny of any commercial operation for low maintenance cost and dependable performance . . . After the war, Jacobs will also have new models for light planes and medium transports . . . well worth the immediate attention of plane manufacturers, feeder or freight line operators, private fliers . . . Jacobs Aircraft Engine Co., Pottstown, Pa.

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utilizes the torsional displacement of an engine caused by the propeller torque action against the resilient vibration-damping engine mountings. Whenever an engine begins to give trouble, the warning device causes a small light to flicker or glow over the feathering switch of that particular engine. A typical installation is photographically and diagrammatically illustrated. *Aero Digest*, October 15, 1944, page 94, 2 illus.

Flight Operations

Fuel Consumption. Lt. B. Orchard Lisle. A consideration of the problems attendant upon the work of the R.A.F. or U.S.A.A.F. petroleum service officer in projecting the amount of fuel which will be required by his unit for a given period. While the utility of gasoline-consumption tables is indicated, different factors are described which tend to make their accuracy variable. Some statistics are given on the volume of petroleum being consumed by British and American aircraft operating from the United Kingdom. *The Aeroplane*, September 1, 1944, pages 247, 248.

Should the Flying Control Officer Be a Pilot? Lt. R. G. Worcester. A discussion of the desirability of having a qualified pilot as the officer in charge of a control tower. While arguments against having a Control Officer who is also a pilot are considered, the conclusion is that the indicated advantages of pilot experience for the control job outweigh possible disadvantages. Attention is also called to the fact that flying control has now become scientific and specialized work. *The Aeroplane*, September 22, 1944, page 333, 1 illus.

Flight Testing

Lightplane Test Pilot. Paul H. Dietz. A test pilot outlines the specific checks that are made when the manufacturing firm flight-tests a light plane. His report briefly tells what is covered during routine production testing, experimental test flying, and demonstration flying for Army and Navy contracting officers. The purposes of the different kinds of flight tests are noted, as well as some of the problems commonly encountered during the tests. *Air Pilot and Technician*, October, 1944, pages 6, 7, 3 illus.

Fuels

Altitude Vapor Formation in Aircraft Fuel Systems. W. H. Curtis and R. R. Curtis. This paper describes an investigation of vapor formation in aircraft fuel systems at altitude. A series of tests were made with a simulated fuel system. This test equipment is described and illustrated. The results of five tests runs are listed. Some of the conclusions are: (1) The operation of a centrifugal fuel-booster pump properly installed will reduce the vapor potential of fuel on the discharge side of the booster. (2) The use of an electric-motor-driven fuel pump at any point in the fuel line between the fuel tank and the engine fuel pump has no effect upon the altitude at which vapor may appear in the carburetor, nor does it reduce its volume. Refinements in procedure and additional tests should permit the development of evaluation factors that will increase the usefulness of this technique. *SAE Journal*, October, 1944, pages 460–465 (Transactions), 14 illus.

To guard against the possibility of water in 100-octane gasoline, Douglas Aircraft Company employs this alternate static vent drain of transparent Tenite plastic in the fuel system of one of its planes. If any water should be present, it is automatically drained to this vent.

Studies of Fuels and Fuel System Phenomena Contributing to Aviation Vapor Lock. A. E. Robertson and R. Albright. It is pointed out that a small amount of vapor will cause vapor lock in aircraft fuel systems, and this trouble may even occur far below the boiling point of the fuel, especially when dissolved air is present in the fuel. Although the solubility of air in aviation fuel is not great, the vapor formation accompanying its evolution may be out of all proportion to the amount present. An equation is presented which makes it possible to predict the equilibrium amount of vapor that a gasoline will form for given initial and final conditions of temperature and pressure. With a knowledge of the temperature and pressure characteristics of a given fuel system, the vapor-liquid conditions existing throughout the system can be estimated in those cases where the initial condition of the fuel with respect to air saturation is known. *SAE Journal*, October, 1944, pages 466–471, 500 (Transactions), 7 illus.

Gliding and Soaring

The TG-3A. Ernest Schweizer. The writer discusses the design and development of the TG-3A two-place training glider, which was produced between July, 1942, and July, 1943. This glider is a development of the TG-2, which was built when the War Production Board limited the use of aluminum alloys to combat aircraft, and is basically similar to it. Information is given about the design of the component parts of this wood glider and the equipment used. It is noted that the landing gear construction is similar to the SGS2-8. *Soaring*, May-June, 1944, pages 8–10, back cover, 3 illus.

High-Altitude Flying

Altitude Chamber for Study of Heating and Air Conditioning Problems. W. E. Crowell. The writer describes some of the problems encountered in high-altitude flight and shows how the altitude chamber may be used to solve many of them. After describing the altitude chamber at the Curtiss-Wright Research Laboratory, the paper discusses the effect of altitude on man. The oxygen and temperature requirements of the human body are considered and some comments are made about aeroembolism and the effects of dry oxygen and air on the throat and nostrils. The effect of altitude on the equipment of the aircraft is then discussed in sections dealing with expansion and contraction, the viscosity of oils, electrical equipment troubles, and other problems. The latter part of the article deals with the heating of airplanes and pressurized cabins. *Heating, Piping & Air Conditioning*, October, 1944, pages 597–602 (ASHVE Journal Section), 6 illus.

History

The First Stratosphere Flight. Maurice Roddy. The story is told of the stratosphere flight made by Major R. W. Schroeder on February 27, 1920. Flying in a Liberty-powered Lepere equipped with a specially developed turbosupercharger, the Major is reported to have attained a height of 38,000 ft. In addition to being cited as the first stratosphere flight, this experiment is credited with having been responsible for another milestone in American aviation development. It is said that the good results obtained with the turbosupercharger for this flight caused appropriations to be made which permitted continuance of turbosupercharger research. A brief outline of Major Schroeder's aviation career supplements the account of the flight. *Southern Flight*, October, 1944, pages 38, 39, 76, 2 illus.

First Round-the-World Flight Made 20 Years Ago. An account of the first flight around the world, made by U.S.A. Army personnel between April 6 and September 28, 1924. Flying in Douglas Cruisers, the men are reported to have traveled a total distance of 26,345 miles in a total flying time of 363 hours, 7 min. The article contains a list of the flight personnel and what they are doing at present; a list of ground personnel who participated in the servicing of the aircraft at various stations; names of various newspaper-

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This power unit comprises a reservoir, electric driven pump and necessary valves, all completely self-contained. Quick-disconnect electrical plugs and self-sealing hydraulic couplings are provided. The unit can be located anywhere in the airplane and its operation electrically controlled from the cockpit.

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2. Absence of extended hydraulic lines means less weight for the complete, installed system.
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A Technical Paper, presented before the November 10th meeting of Institute of Aeronautical Sciences, "Some Design Considerations of Electro-Hydraulic Power Supply Systems" is available to engineers who write for it on Company Letterhead. Pacific Division, Bendix Aviation Corporation, North Hollywood, California. Sales Engineering Offices in New York and St. Louis.

This Altair Electro-Hydraulic unit delivers 1 1/4 GPM minimum at 800 PSI. Overall dimensions are 10" x 11 3/16" x 16". Weight: 29 Pounds.

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men assigned to report the flight; and the route of the flight, together with the indicated number of statute miles between each landing point. *U. S. Air Services*, October, 1944, pages 19, 20, 40, 3 illus.

Correct Procedures for Tying Down Airplanes. Basic procedures are given for fastening airplanes securely to the ground when parked in open airfields. How reactions produced by the wind affect this procedure is explained. Information is supplied about the design and installation of concrete anchor blocks. Other types of tie-down anchors are described. A chart shows the various procedures for tying down airplanes and also illustrates certain methods to be avoided. *Aviation Maintenance*, October, 1944, pages 76–88, 184, 186, 12 illus.

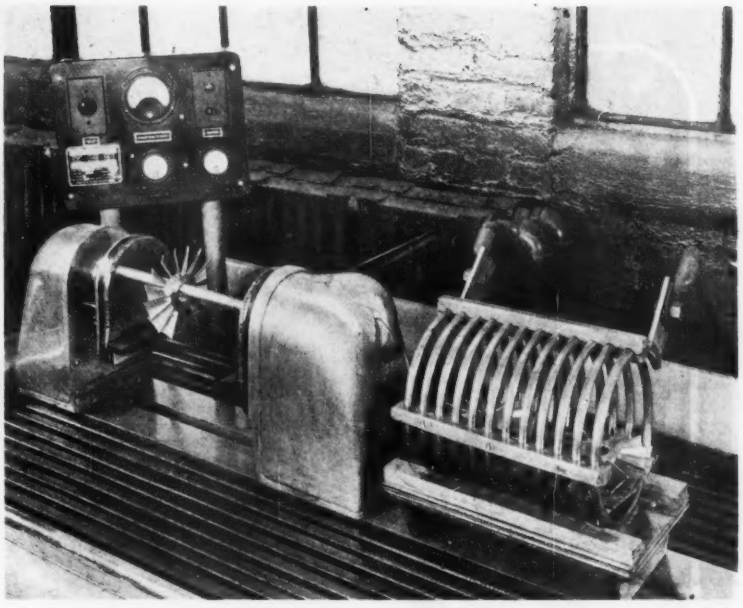
Inspection

How Filtering of X-Ray Beams Improves Radiograph Quality. Robert Taylor. Information is given about the use of metallic filters for altering the radiation to meet the varying conditions imposed by different metals and alloys in radiographic inspection work. Terms such as "hardness" and "depth-percentage intensity" are defined, and the effects of the interposition of filters on these properties are explained. Specifications are suggested for filters of the proper dimensions and compositions for inspecting different metal parts, as well as the technique required. The effectiveness of the filters is explained with the aid of reproductions of radiographs made with and without filters. Comments are given about the improved methods continually being developed in this field. *Aero Digest*, October 1, 1944, pages 88, 89, 214, 7 illus.

Measuring and Designating Surface Finish. Parts I and II. James A. Broadston. Parts I and II of a three-part article discuss the measurement of surface finish and describe a system of designation that clearly shows which surfaces are critical and which are not. The system permits the allowable roughness of critical surfaces to be defined in microinch units and is stated to provide an adequate means of controlling the surface quality of machined precision parts.

In Part I the writer reviews what has been common practice in designating surface finish and discusses types of surface irregularities and standards of roughness values. Consideration is given to surface terminology, the Root Mean Square microinch value, the R.M.S. microinch symbols, and the preferred roughness values.

Part II deals with measurements of surface roughness by the profilometer and the Brush analyzer. The use of the Amsler integrator to determine precise R.M.S. values from profile curves produced by either the taper section photomicrograph or the Brush analyzer record tape is described. *The Iron Age*, October 19, 1944, pages 62–66, 7 illus.; October 26, 1944, pages 76–81, 9 illus.; "Distinctive Symbol Adopted to Designate Surface Finish," by James A. Broadston, *Product Engineering*, October, 1944, pages 704–706, 5 illus.



A Magnaflux machine used for inspecting surface perfection of machine forgings at the Cadillac Motor Car Division of General Motors Corporation.

Planned Inspection Improves Quality Control. Herbert Chase. As employed by the Fort Edward plant of the General Electric Company, planned inspection procedures for obtaining quality control are outlined. Features of the system to which attention is called include the use of operation inspection tags; first-piece checks; special fixtures for the facilitation of measurements; and selective assembly aids in holding certain close limits. In addition to photographs of equipment employed in the checking processes, illustrations are shown of the paper forms that help to facilitate the work. *Wings*, November, 1944, pages 1276–1278, 9 illus.

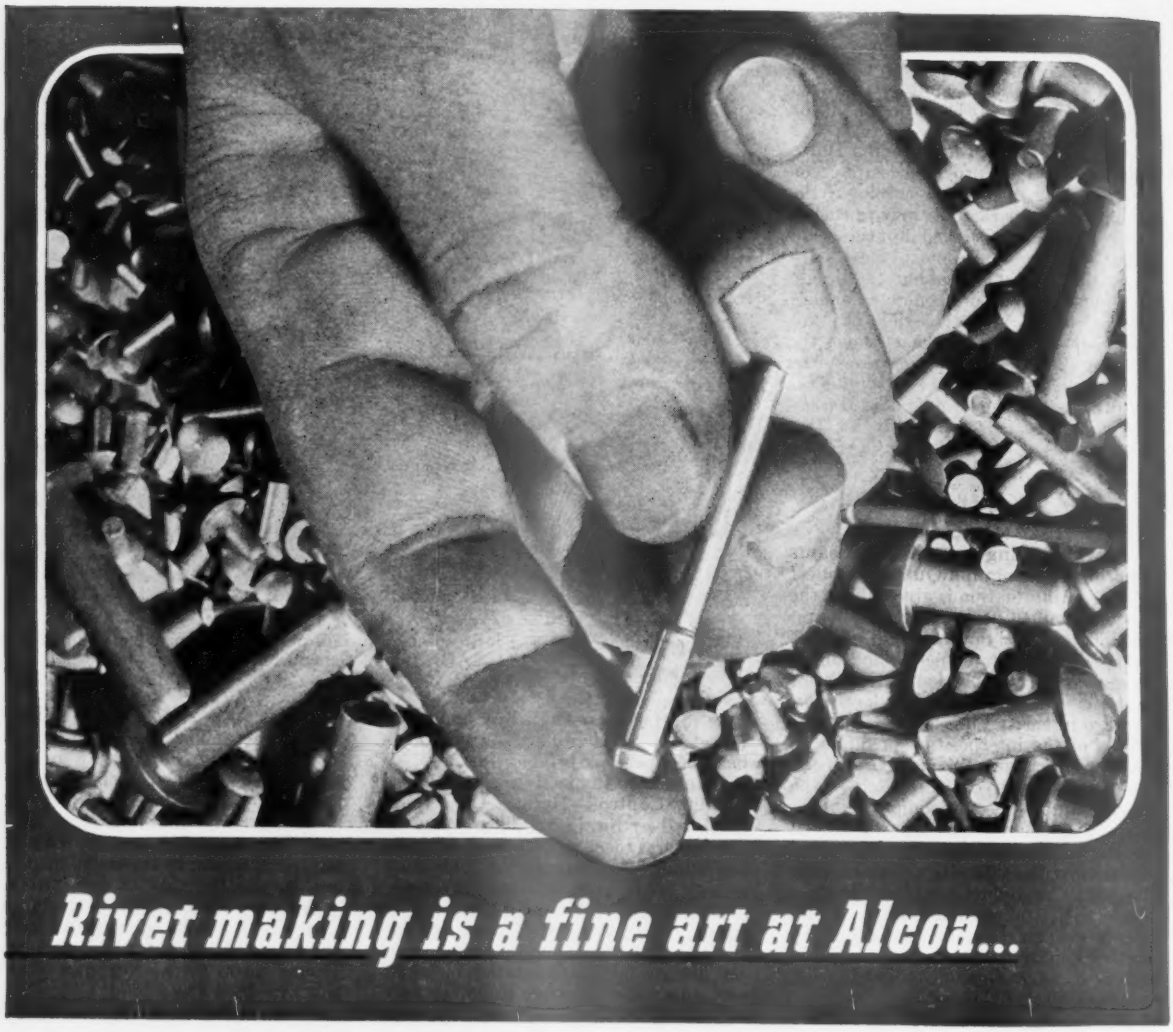
Inspecting Spot Welds by X-Ray. Robert Taylor. The spot welding of aluminum-alloy parts and X-ray methods of inspection are discussed. Sections of the article deal with the preparation of the sheet for welding, the electrodes, spot-welding machines, and X-ray inspection techniques. *Industrial Aviation*, October, 1944, pages 55, 56, 58, 102, 5 illus.

Instruments

Let's Make Instruments Flight-Like. Capt. Ken Lester. The design of flight instruments to picture the situations that they interpret is suggested and discussed. Explaining the advantages to be gained by such design revision, the writer analyzes the mental exercise that is required to interpret the indications of three different types of flight instruments: "fact" instruments, as typified by the altimeter; "symbol" instruments, as typified by the needle-ball assembly; and "attitude" instruments, exemplified by the gyro horizon. He then shows why reference to the attitude instruments is simpler than any others because they most nearly portray the apparent motion they are meant to report. The gyro horizon is named as the instrument that is the most flightlike of any, although suggestions for its improvement are included with specific suggestions for the improvement of other flight instruments. *Air Facts*, November, 1944, pages 19–28, 4 illus.

For Accuracy in Aerial Photography. A brief article describes and illustrates an improved lens collimator, especially designed by engineers of Fairchild Camera & Instrument Corporation for final testing of Fairchild aerial camera lenses after installation in the cameras. Its purpose is to give a photographic record of the resolving power of each lens for correct focusing. *Instruments*, October, 1944, page 613, 2 illus.

System for Indicating Positions of Landing Gear and Flaps. Details are given on the construction and operation of an indicating system that enables the pilot of an aircraft to ascertain the exact position of his landing gear and wing flaps at all times. Employing the selsyn principle of remote indication, the system is a compact one consisting of two basic parts—the transmitter and indicator. It is manufactured by the General Electric Company and is produced in two types: one is known as the "A-N, Two-coil D-C Selsyn System"; the other is known as the "Two-wire Two-coil D-C Selsyn System." With energy supplied from a 28-volt battery, the principle involved is to vary the current in two coils in the indicator, in some predetermined relation to the movement of the landing gear or flaps, by means of a brush mov-



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How-to-do-it information is contained in Alcoa's booklet, "Riveting Aluminum". Also available is the catalog "Standard-Screw Products" which contains weight and dimensional data on standard Alcoa rivets. Copies will be sent to you free. The sound motion picture, "How to Rivet Aluminum", depicts the making and testing of rivets, preparation of the work, the actual riveting and final inspection. This picture may be borrowed from the Motion Picture Department, ALUMINUM COMPANY OF AMERICA, 2142 Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA ALUMINUM

ing over a resistance bridge in the transmitter. Schematic drawings illustrate the mechanics of the system. *Aero Digest*, October 1, 1944, pages 80–82, 5 illus.

Needle, Ball, and Ripcord. Lt. (j.g.) Robert W. Duncan. Advice is given on how to use the turn-and-bank indicator to best advantage. Five possible positions of the needle-ball assembly are described, with notes to the pilot on how to correct each attitude to obtain proper straight flight. It is explained also how these corrections work when the plane is inverted and recovery to straight flight is desired. The recommendation that the pilot always translate the indications of the instrument to airplane attitude is stressed. *Air Facts*, November, 1944, pages 62–66.

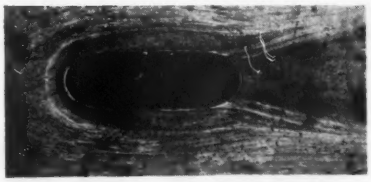
Electrically Operated Gyroscopic Instruments. H. Konet. This article discusses the electric gyroscope for aircraft instrumentation. Types described include vertical gyroscopes, the precessional gyroscope, the gryo-horizon indicator, the driftmeter, the gyro-roll indicator, the electric turn-and-bank indicator, the Gyro Flux Gate compass system, and the automatic pilot. Problems connected with production are considered. It is stated that for aircraft the electric gryoscope is rapidly supplanting air-driven types because of the following factors: (1) freedom from air-supply requirements at high altitudes; (2) sealing and elimination of air supply, thus preventing contamination and insuring greater reliability; (3) greater versatility, especially where electrical signaling devices are required; (4) compactness and greater reliability under extreme temperatures because of speed regulation and torque characteristics. *Electrical Engineering*, October, 1944, pages 735–738 (Transactions), 8 illus.

Landing Gear

Prerotation of Landing Gear Wheels. Henry F. Schippel. This paper describes the latest developments in one method of starting the landing wheels of aircraft to revolve before they make contact with the ground. The method discussed makes use of flexible vanes on the tires which cause them to rotate as soon as the wheels are lowered for a landing. An explanation is given of tests conducted to determine the position and angle of the vanes, the best operation of the landing gear, and the proper landing speed. A study of the airflow patterns is included. Results are tabulated and charted. *SAE Journal*, October, 1944, pages 486–491 (Transactions), 17 illus.

Lighter-Than-Air

In Rebuttal, on Behalf of the Airship. Hugh Allen. Extolling the qualities of the airship, this article is a reply to another article that appeared in a previous issue of the same magazine. In the earlier article four reasons were given for the writer's conclusion that he did not see promise of the early commercial practicability of the airship. In this article these reasons are contested. Testimony is given for the airship's ability to pick up and launch airplanes without slowing down, its ability to maintain flight schedules in spite of weather hazards, and the various factors of comfort and convenience which compensate for the airship's slower speed in comparison with airplanes. It is also affirmed that adequate terminal facilities for commercial airship traffic are already in existence, without necessitating the expenditure of huge sums of money. These are the Navy's blimp bases, which can be converted for commercial use. *U.S. Air Services*, October, 1944, pages 28, 41.



The airflow pattern around a B. F. Goodrich smooth-contour prerotatable landing-gear tire taken in a plane through the center of the axle. The photograph was of a 9-in. tire model at an air speed of 60 m.p.h.

Lubrication

Aircraft Lubricating Greases. R. S. Barnett, F. E. Tobin, and Gus Kaufman. Information is provided for the maintenance man regarding the lubricating greases required for the various parts of aircraft and the way to utilize and apply these lubricants to the best advantage. Following general remarks concerning the lubrication of antifriction bearings, specific instructions are given for the application of lubrication techniques to military and commercial aircraft. *Aviation Maintenance*, October, 1944, pages 56–59, 162, 166, 168, 170, 4 illus.

Maintenance

Job Procedures to Facilitate Repairs. This article discusses the application of production illustrations, supplemented by instructions for job procedures, to aircraft maintenance and repair. It describes an experimental study dealing with the development of production illustrations and job procedures for use in the Assembly and Repair Department of the U.S. Naval Air Station at Alameda, Calif., which was conducted by the Industrial Engineering Division. The study was confined to the installation of Bureau of Aeronautics fuselage changes in the OS-2U-1, -2, -3, and OS2N-1 airplanes. The procedures are explained at length and a chart is reproduced showing the combination of illustrations and instructions. *Aviation Maintenance*, October, 1944, pages 68, 69, 186, 188, 190, 192, 196, 198, 200, 202, 2 illus.

When It Rains. A. L. Jacobs. Naming components and accessories of an aircraft which are particularly susceptible to rain and dampness, the writer advises procedures for avoiding, checking against, and repairing the deteriorating effects of moisture upon an airplane. His suggestions refer to control cables, small hardware, ball-bearing installations, adjustable stabilizers, longerons and cross members, and wing coverings. Other items are engines and engine controls, cowling and fasteners, propellers, tail skids, landing-gear axles and tail-wheel assemblies, rubber bungee shock absorbers, oleo shock struts, external brace wires, and interior upholstery and wood trim. *Air Pilot and Technician*, October, 1944, pages 12, 13, 1 illus.

Aircraft Cleaning. Part II. Gilbert K. Brower. The concluding section of a two-part article describes the methods and equipment used in cleaning aircraft. The cleaning problems common to all air-transport operators are reviewed with regard to detergent materials used and procedure followed Such problems include exterior cleaning of aircraft, cleaning of plane interiors, engine-parts cleaning after disassembly, paint stripping, and miscellaneous subjects such as oil tanks, spark plugs, preparation for plating, glass and plastics, etc. Types of equipment of interest to air-transport operators are discussed. These include blast-cleaning units; tanks, without equipment or equipped with means for heating, temperature control, agitation, ventilation, etc.; vapor degreasing; chemical or steam vapor cleaners; mechanized washing machines; and burnishing barrels. Consideration is given to the relative advantages of chemical and steam-vapor cleaning. *Air Transport*, October, 1944, pages 91, 94, 97, 1 illus.

How Landing Gear Service is Handled at Northwest Airlines. Ed. Parker. The highlights are given of service procedures at a specialized landing-gear shop where the landing gear of air-transport planes are inspected and overhauled. *Aviation Service Magazine*, September-October, 1944, pages 24–28, 9 illus.

Production Line Carburetor Overhaul. Paul F. Adair. The application of quantity-production methods to carburetor overhaul is described in this article, which deals with the procedure employed by Air Service Command depots. The successive steps in production-line overhaul are described and illustrated. *Aviation Maintenance*, October, 1944, pages 48–51, 148, 150, 154, 156, 158, 162, 40 illus.

Corrosion. Part II. Ray Sanders. This is the second of a series of articles on corrosion prevention, cleaning, and other problems connected with aircraft maintenance. Subjects discussed include: the chemistry of engine overhaul; the occurrence of electrolytic corrosion when certain dissimilar metals are immersed in the same cleaning solution; the preservation of chromate castings; cleaning solutions; and cleaning-solu-

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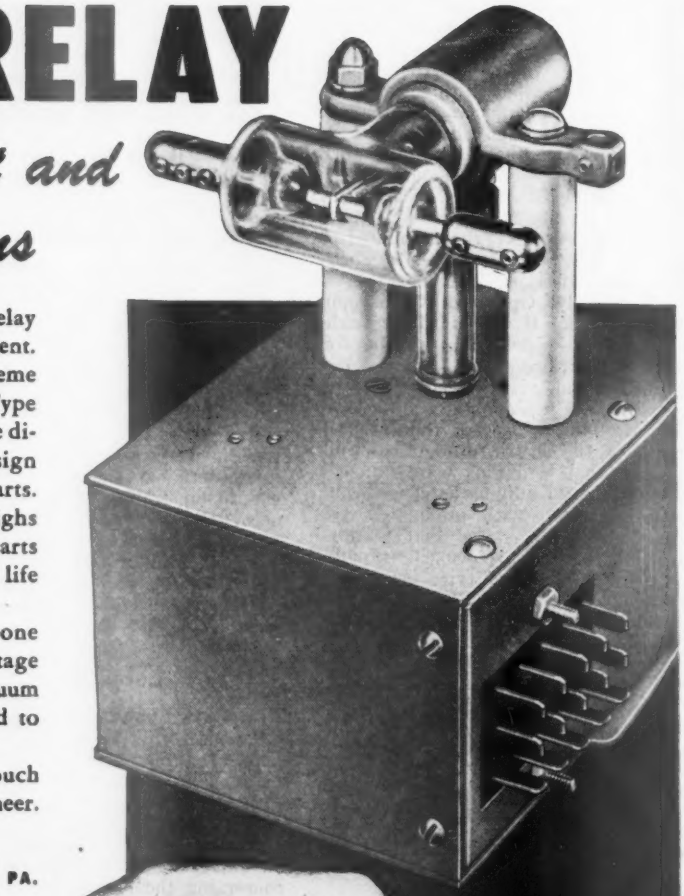

Here is convincing proof that a keying relay does not have to be complicated to be efficient. In fact, just the reverse! Actually, the extreme reliability with which Struthers-Dunn Type 78CCA100 Relay holds its adjustments is the direct result of its new simplified and rigid design which utilizes an absolute minimum of parts.

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tion control. *Air Tech*, November, 1944, pages 28–30, 72, 7 illus.

Management

Weight as the Key to Waste Control. Raymond A. Nathanson. Lockheed Aircraft Corporation's method of using weight as a basis for indicating the percentage of scrap generated by any fabrication operation is explained. Various investigations conducted by the Conservation Department to establish this means of waste control are reviewed, and the paper forms employed for the recording of scrap percentages are described. With the Sheet Metal department as an example, it is demonstrated how reports are made on the amount of material orders entering the department; the weight of these orders at the time of entrance; the type of material; the scrap generated from each alloy at each operation; the material rejected because of damage; the sweepings generated in the section; the mixed borings in the section; and, finally, the percentage of scrap as figured from a compilation of the foregoing elements. *Aero Digest*, October 1, 1944, pages 117, 118, 212, 4 illus.

Marketing

How Will Postwar Planes Be Sold? James A. Wales, Jr. Three postwar distribution plans are outlined for the aircraft manufacturer. In each plan the factor of adequate control is stressed. Primarily, this factor is interpreted as the establishment of standard sales and service facilities at major sales outlets, with predetermined standard charges made for certain service and overhaul jobs. However, it is also described as including the standard training of salesmen and the uniform physical appearance of various merchandising material, such as signs and posters. The value of a well-planned system in reducing distributing costs and promoting the sales of planes is indicated.

The three plans are called a Dealer Plan, a Distributor Plan, and a District Sales Office Plan. The first involves the appointment of direct factory dealers by the manufacturer's sales manager. It features bringing the dealer into the plant for an intensive training course in the design, construction, and maintenance of the airplane he is to sell; giving him a complete sales course; and schooling him in the company's standard accounting and general business procedures insofar as they will affect his own operations. The Distributor Plan is similar to the Dealer Plan except that the territories are larger and the quotas are proportionately higher. Each distributor has several dealers working directly under him in preassigned subdivisions of his own territory. The third plan calls for the operation of the dealers under the supervision of branch offices and warehouses, one to a district, managed by the district manager. Under this system the district man is, in effect, a large distributor, except that he is an employee of the manufacturing firm and not in business for himself. *Aviation*, October, 1944, pages 124, 125, 270–277, 3 illus.

Programming of Aircraft Parts Distribution and Service. Franklin M. Reck and Edward L. Warner. This survey of the postwar plans of various aviation and automotive companies shows an existing basis for an expansion of parts distribution and airplane service. It takes into consideration the channels and methods by which engine companies, manufacturers of engine parts, makers of engine and aircraft accessories, wholesale distributors, and local dealers expect to offer their aircraft products and services to the public. Figures are quoted from a recent survey made by the Automotive and Aviation Parts Manufacturers Association indicating the extent to which new companies have entered the aircraft-parts business during the war and the number who intend to stay in the airplane business after the war. The questions of how far automotive-parts distributors want to share in the aircraft-parts business and how many automobile dealers will want to sell a line of airplanes are touched upon. Attention is also called to the need for simplification and standardization of many aircraft supplies and parts. *Aero Digest*, October 15, 1944, pages 75–77, 150, 152, 3 illus.

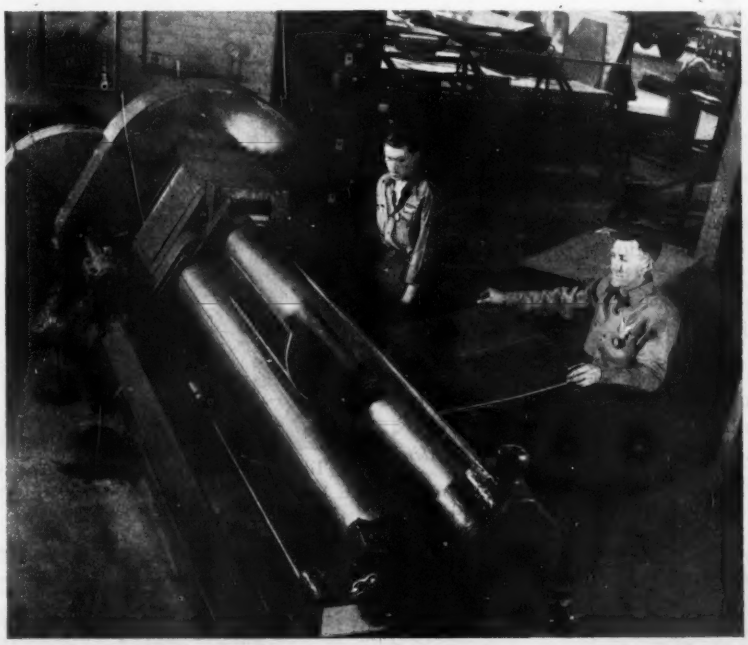
Materials

The War's Foremost Achievements in Materials and Methods. Edwin F. Cone. A report is given of a survey made with the object of obtaining a coordinated appraisal of the metallurgic achievements in the development of new materials and methods resulting from the war effort. The opinions of many well-informed men regarding generally known developments are summarized. Sections of the article discuss the light metals, the NE steels, high-temperature resisting steels, boron in steel and iron, achievements in the foundry industry, powder metallurgy and carbon tools, and other developments. Ten leading wartime engineering materials and methods of development are outlined. *Metals and Alloys*, October, 1944, pages 916–921, 4 illus.

Delignified Impregnated Wood. Foster Luce. This article discusses the delignification of wood, which, it is explained, is the treatment of wood chemically with heat and pressure before the veneer layers are impregnated or bonded. Details are given about the delignification and impregnation processes. How papermaking technique has been borrowed for the process is described. Other sections of the article discuss impregnating materials and the kinds of wood that may be treated. *Mechanical Engineering*, pages 654, 655, 657.

75S-Alcoa's New High-Strength Aluminum Alloy. J. A. Nock, Jr. An engineering analysis is made of the nature, properties, workability, and applications of 75S aluminum alloy. The subject is treated in sections dealing with the mechanical properties and heat-treatments, formability, resistance to corrosion, and joining. Tables and graphs give the mechanical properties. *Metals and Alloys*, October, 1944, pages 922–925, 6 illus.

High-Strength Centrifugal Castings. Stanley P. Perry. A brief description is given of recent research that has resulted in centrifugally cast steels having a tensile strength of 180,000 lbs. per sq.in. and a ductility of 10 per cent. The process of casting such



Roll forming of sheet metal at a plant of the Reynolds Metals Company.

steels is outlined. A table gives a comparison of the mechanical properties of centrifugally cast and wrought pierced steel tubing. *The Iron Age*, October 5, 1944, pages 52, 53, 3 illus.

R301—Reynolds' New High-Strength Aluminum Alloy. T. L. Fritzlen and L. F. Mondolfo. A technical description is given of the composition, properties, and treatment of R301, a new Clad material consisting of a high-strength core alloy clad with a medium-strength corrosion-resistant alloy. The material was developed to meet the needs of the aircraft program. Tables contain data on the properties of the material, solution, treatment times, heat-treatment times, aging times, etc. Micrographs of the material are reproduced. *Metals and Alloys*, October, 1944, pages 926–933, 28 illus.

Adhesives for Metals and Nonmetals. Kenneth Rose. The writer classifies and describes the most important cements developed for joining metals to each other or to nonmetallic materials such as wood, plastics, rubber, and glass. The present and future uses, possibilities, and limitations of these adhesives are discussed. *Metals and Alloys*, October, 1944, pages 959–963, 5 illus.

Medicine

A Comparison of Altitude and Exercise with Respect to Decompression Sickness. S. F. Cook, O. L. Williams, W. R. Lyons, and J. H. Lawrence. A study of the comparative effects of altitude and muscular exercise upon decompression sickness. The conclusion reached is that an increase in altitude from 30,000 to 38,000 ft. increases the incidence and severity of decompression sickness considerably more than does an increase in the muscular work of a subject.

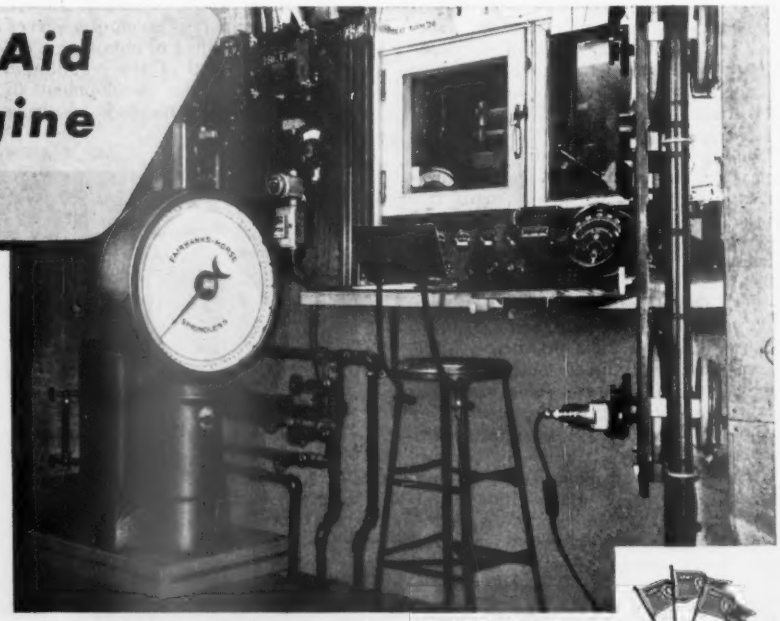
The experiment was conducted by giving four groups of healthy young men (ages 18 to 20) two chamber tests each. One group was taken to the equivalent of 30,000 ft. and performed a standard exercise every 5 min. for 90 min. The second group performed the same exercise every $2^1/_2$ min. at this simulated altitude. The third group was taken to 38,000 ft. and performed the standard exercise every 5 min., and the fourth group performed the exercise every $2^1/_2$ min. at 38,000 ft. Criteria used to compare the bends-inducing effect of the four sets of conditions consisted of per cent incidence of symptoms, per cent incapacitation, time of onset of symptoms, time of descent, maximum intensity of symptoms, and velocity of development of symptoms. All criteria are reported to have shown statistically significant differences between the two altitudes with constant exercise. When altitude was held constant at 30,000 ft., the effect of doubling the frequency of the standard exercise was relatively slight and not in all cases of statistical significance. At 38,000 ft., the effect of increase of exercise was significant with most criteria, but much less pronounced than the effect of changing altitude. *War Medicine*, September, 1944, pages 182–187.

Meteorology

The Use of Cross Sections in Briefing Away Traffic Controllers. Emil S. Kurtz. It is stated that since the establishment of the Flight Advisory Weather Service, the usefulness of cross sections has been demonstrated in portraying significant cloud and weather phenomena along the airways to pilots and Airway Traffic Control personnel. It is explained that the purpose of the particular type of cross sections being employed in F.A.W.S. centers is, primarily, to help the Advisory Meteorologist convey to the Airway Traffic or Army Flight Controllers a clear picture of existing weather conditions along the airways in the control area. The general procedure for the construction of cross sections is described. *Bulletin of the American Meteorological Society*, September, 1944, pages 307–310, 2 illus.

Service Flyers Brave the Hurricane. Capt. Burr Leyson. From the experiences of Navy and Army air crews in locating and tracking the recent hurricane, which swept the Eastern seaboard of the United States the effects of such weather disturbances upon air-transport operations are reported. It is stated that hurricanes present no obstacles to long-

Scales Aid Plane Engine Testing



UNCLE SAM takes no chances with aircraft engines. Before they're mounted, they must be tested for power developed, heat, and gas and oil consumption. Doing the latter job at Continental Motors is a battery of Fairbanks-Morse Fuel Test Automatic Dial Scales.

Fairbanks-Morse Scales can do an accurate job for you, too. Their dependability and simplicity of design are backed by *114 years of scale-building experience.* Fairbanks, Morse & Co., Fairbanks-Morse Bldg., Chicago 5, Ill.

Test engineer's observation post outside an individual engine test cell, showing the Fairbanks-Morse Scale and the gauges which indicate engine performance.

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Piston Rings for Oxygen Compressor
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Pistons for Air Compressor
Pins for Air Compressor
Piston Rings for Air Compressor

LANDING GEAR PARTS
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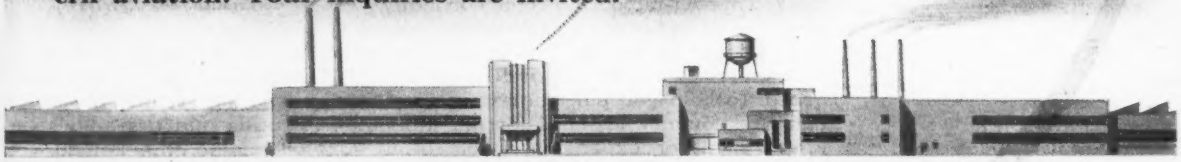
Hardened and Ground Parts



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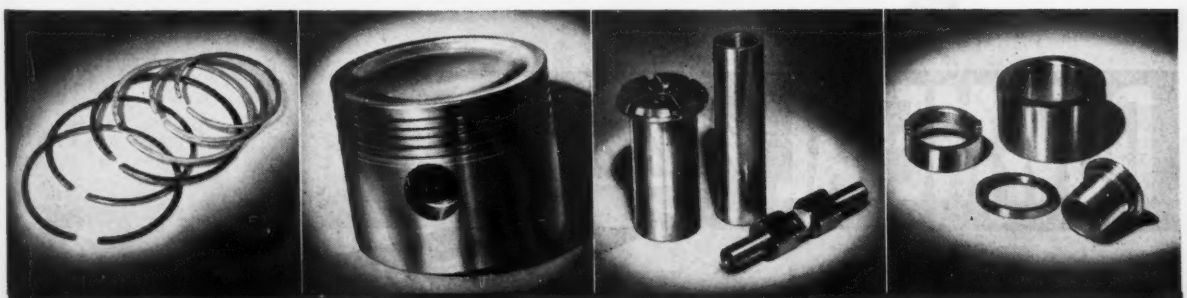

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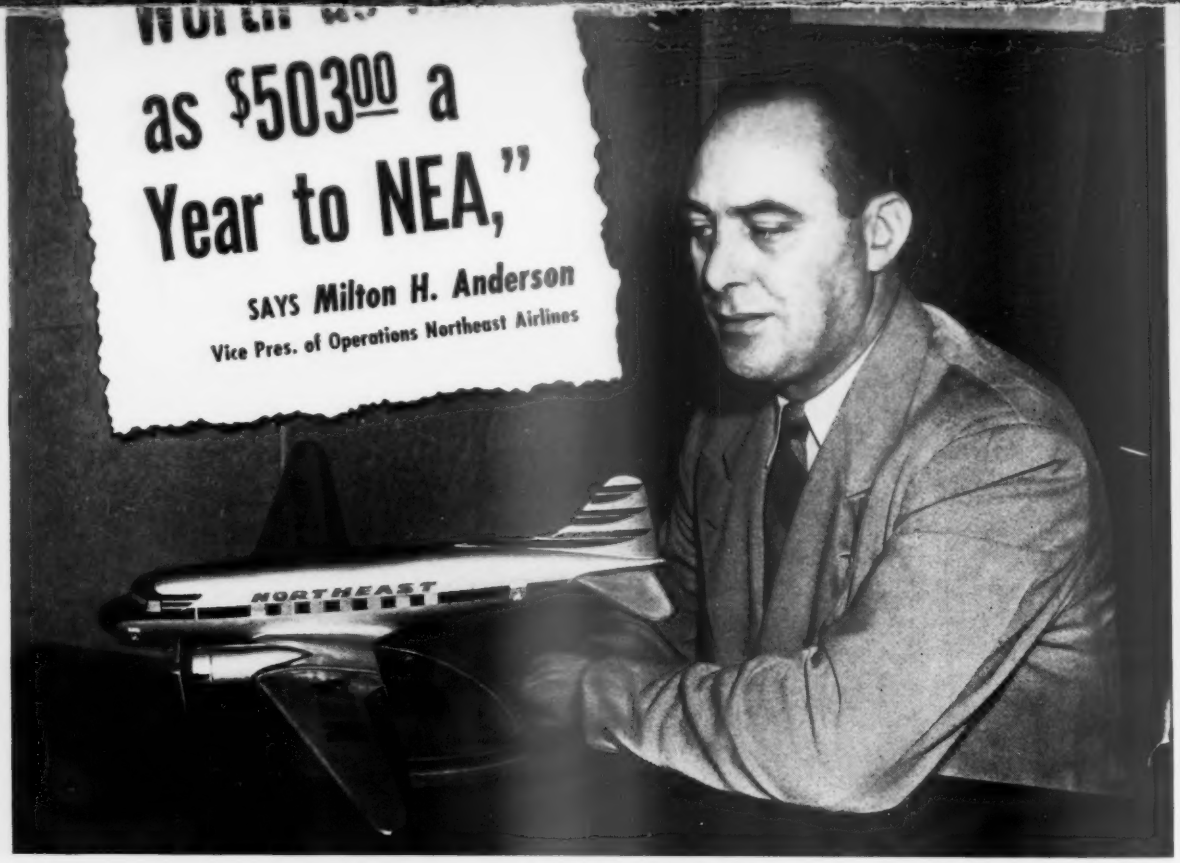

"Our experience in New England over a period of years emphasizes the value of every pound of increased pay load. Each pound of unnecessary weight saved can mean that much more for passengers and cargo. For example, one pound of excess weight on the Boston-New York run, operated with 24-passenger DC-3's on hourly schedules, could cost Northeast as much as $503.00 a year."

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- Lighter, tougher, Boots step up cargo capacity.
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- Can be used again and again—yet self-locking grip never slips.
- "Outlast the plane."

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BOOTS STEEL ANCHOR NUT

(W2S = 8-32) The comparable fibre nut is 151.2% heavier than this all-metal, steel self-locking nut.

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Actual weights of over 250 different self-locking nuts used in aircraft, comprehensively reviewed for the convenience of aircraft designers, engineers, operating and maintenance personnel. Copy will be sent you, free, on request.

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360 JAP PLANES DESTROYED IN ONE DAY
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INSURE DEPENDABLE IGNITION!

The Navy's great fighter, the Hellcat built by Grumman, is setting almost daily, unparalleled records in combat. The combination of Navy pilots' skill, courage and daring, and the obviously great ships that they fly, is a winning one. "Hot" pilots and "hot" engines go together. Champion Spark Plugs and "hot" engines likewise go together, and championship performance is always the result. So today they are firmly established as true champions in the air, as they are on land and water. Champion-Ceramic Aircraft Spark Plugs are standard equipment in the Pratt & Whitney engine which powers the Grumman Hellcat. Thus Champions continue to demonstrate their better performance and outstanding dependability in service where spark plug dependability may spell the difference between being victor or vanquished. Champion Spark Plug Company, Toledo 1, Ohio.

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SHOCK!
STEEL
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METAL-TO-METAL contacts cause SHOCK . . VIBRATION . . NOISE . . WEAR . . DESTRUCTION!
RUBBER
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RUBBER-TO-RUBBER contacts ABSORB shock . . . MINIMIZE vibration . . . MUFFLE noise . . . PROLONG LIFE of moving parts!
Cut-away view of threshing mechanism in a modern combine. Rubber faced steel cylinder bars, operating in connection with a rubber stripping plate, and two stationary block rubber concaves, protect hard and soft shell crops from damage.

SHOCK is the foe of machinery. SHOCK and resultant VIBRATION caused by metal-to-metal contacts of moving parts are fast being eliminated by modern processes of rubber-to-metal adhesion.

A "striking example" of metal-to-metal *versus* rubber-to-rubber contacts is the development of the modern combine or "all-crop harvester."

ORCO engineers, working closely with farm machinery engineers, applied modern rubber adhesion processes to eliminate metal-to-metal contacts in threshing mechanisms.

The "end result" was elimination of SHOCK which in old style harvesters limited the machines to hard shell crops and often caused damage to both crops and machines.

Rubber-to-rubber contacts now widen the scope of the modern combine to include soft shell as well as hard shell crops. Machines last longer. Crops are protected against crushing. Operators are relieved of fatigue caused by excessive noise and vibration.

When YOU encounter problems involving SHOCK and VIBRATION in moving parts of machinery, ORCO engineers are prepared to co-operate. Ask for ORCO-OPERATION!

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October 15, 1944, pages 22, 23, 88, 90, 92, 5 illus.

Basic Principles of Power Boost Flight Controls. E. G. Riley. In opening this discussion of power-boost flight controls for large aircraft, the writer describes various substitutes for power boost which have been tried. It is stated that all of these have disadvantages that prevent their use on large aircraft. The requirements for a successful power-boost system then are outlined. Consideration is given to the location of the major elements, and the conditions requiring boost control are listed and discussed. The boost system used on the Martin Mars is described in sections dealing with the elevator control system, the pressure source, safety features, and the automatic bypass valve. *Industrial Aviation*, October, 1944, pages 7–9, 94, 95, 4 illus.

Deicing

The New T.K.S. Airframe De-icing System. The principles, operation, and equipment of a British airfoil-deicing system are detailed. Called the T.K.S. system, this is based upon the use of chemical deicing fluid capable of mechanical distribution. Essentially, the system consists of a motor-driven, positive-displacement, multioutlet pump, a deicing fluid filter, a motor controller, deicing liquid, and special metal leading-edge distributors. The deicing fluid is supplied from a suitable storage reservoir to the pump via the filter, each individual pump outlet being piped to one or more of the special metal distributors inset in the leading edges of the wings, tail plane, and fins. The individual pump outlets are calibrated to distribute the correct quantity to the surface served. The liquid is carried by the air stream over all surfaces of the wings, tail planes, fins, and controls, thereby protecting all essential components. Two rates of flow are provided for the deicing liquid—one for normal, and the other for emergency use.

Description of this system is preceded by some general notes on three different methods of airfoil deicing: the "boot" method, the hot-wing process, and the use of chemical deicing paste. *The Aeroplane*, September 29, 1944, pages 359–361, 4 illus.

Design

Progress in Aircraft Design. Bruce Smith. It is noted that the progress in aircraft design during the past 40 years has been steadily upward, as measured by an arbitrary computation of efficiency chosen to bring out the salient points in connection with aerodynamic characteristics. Several simple approaches are given to illustrate the progress made.

A concrete example is given of airplane design improvement by comparing an accepted 1919 design with a hypothetical airplane of the present, both having the same gross weight, span, power, and landing speed. Among the betterments expected in the future are: improved aerodynamic characteristics at high speeds through increased wing critical speed from a compressibility standpoint; incorporation of variable-area means in the tail surfaces; and increase of extensible wing area. Factors other than aerodynamic improvement that have contributed to the higher efficiency are summarized. *Aero Digest*, October 1, 1944, pages 58–60, 5 illus.

"Golden Hind" Goes East. An account of how a Short Empire flying boat of the "G" class, originally intended for civil flying but converted to military use, was reconverted into a civil transport. It is reported that the changing of seating capacity from 40 passengers to 38, the obtaining of a high degree of comfort, and the considerable reduction of the noise level in the cabins entailed an additional weight of about 550 lbs. Two innovations were incorporated: one, a concealed escape hatch working on a press-button system; the other, the fitting of panels to house the "defence" and black-out curtains. Because of the hull primary structure, the passenger accommodation was divided into four compartments, larger than those on the peacetime Empire flying boats but similar in general layout. Extensive use of fabric instead of panels is credited with having saved weight and having been effective for soundproofing. *Flight*, September 21, 1944, pages 315, 317, 2 illus.

Design Engineers Want More Information in Catalogs. E. A. Pinger. The need for improvement in the cataloguing of equipment and hardware articles for aircraft is emphasized. Recommendations contained in a study made by the National Aircraft Standards Committee are given. Advantages of good catalogue files containing specific technical information, proper indexing, and minimum requirements are also discussed. *Product Engineering*, October, 1944, pages 679, 680.

Favoring the Classical in Flying Boat Hydrostatics. W. J. Griffey. Methods of investigating the static water characteristics of a proposed flying-boat hull design are discussed. A comparison is made between the classical methods of naval architecture, modified to suit the requirements of flying-boat design, and the experimental method, involving the building of a scale model. Favoring the classical method, the writer explains the basic principles and steps in making these calculations for determining the draft and trim of the hull when afloat. He gives detailed instructions for determining the normal load water line for a typical flying boat, applying mathematical formulas for calculating the center of gravity, the center of buoyancy, the displacement, the trim angle, and other relationships. Other computations are carried out to show the change of trim caused by the movement of the center of gravity, the transverse stability of the hull, and the determination of metacentric height. Allowances for fuel tanks, and the displacement of side floats also are explained. *Aviation*, October, 1944, pages 159–163, 8 illus.

Pilot's Prescription. Part I. Capt. W. Laing Stewart. The first of a series of articles presenting an air-line pilot's views regarding the development of British intercontinental transport aircraft for the postwar period. In this first article, the writer compares the advantages of air-cooled engines with those of the liquid-cooled type. While indicating why the former have been favored in the past, he shows a preference for the latter type because of its adaptability to tandem mounting, which, he suggests, would be useful in future civil air transports. He advocates employing eight engines mounted in four tandem pairs, in the belief that this type of design would solve stress problems and facilitate lighter construction.

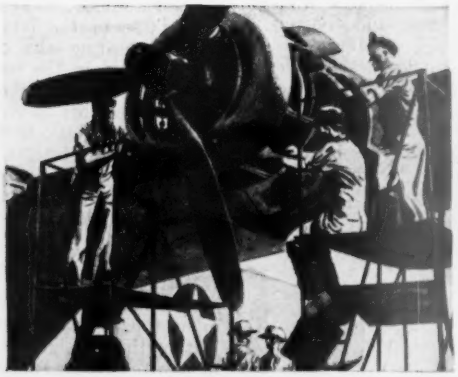
Part I also initiates a consideration of the influence of available runways upon the design of future airplanes. Rather than design the planes to conform with existing runway facilities, the writer intimates that longer runways should be built which could accommodate larger, higher powered landplanes. *The Aeroplane*, September 1, 1944, pages 244, 245.

Pilot's Prescription. Part II. Capt. W. Laing Stewart. This second article of a series gives the writer's opinion as to the deficiencies and merits of British airplane-design development. He also lists the minimum specifications of two types of long-range commercial aircraft which he believes would stand a good chance of competing with the designs of other nations after the war is over. Both are landplanes—one with a maximum weight of 120,000 lbs. and a range of 2,610 miles; the other with a maximum weight of 150,000 lbs. and a range of 3,045 miles. *The Aeroplane*, September 8, 1944, pages 272, 273.

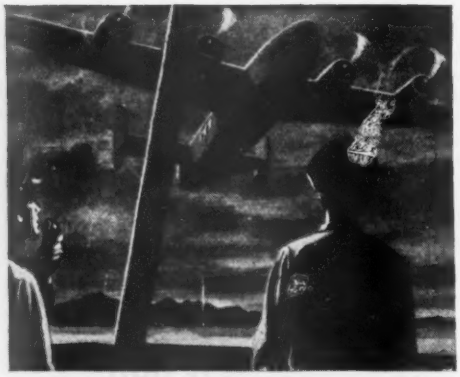
Pilot's Prescription. Part III. Capt. W. Laing Stewart. The third of a series of articles in which an air-line pilot suggests design standards for British postwar civil air transports. Part III contains his comments regarding the design of cockpits or flight decks for large transport planes. He specifies that, in addition to the equipment normally installed at present, a deck for a crew of five should comprise a minimum of five small wardrobes, five lockers, food and drink locker, cabinets for files, logbooks, books of tables, sextants, chronometers, etc., and a lavatory with wash basin. The size of the deck, he believes, should be at least double the area now normally allotted to it. As laid out originally for Pan-American Airways, the Boeing 314 Clipper flying boat is cited as the only airplane known to the writer that at present provides

This advertisement is one of a series which is appearing in national magazines and newspapers as Consolidated Vultee's contribution toward a clearer public understanding of transportation's role in the war, and its postwar opportunities and responsibilities.

To Australia—AND BACK—
in 95 hours and 20 minutes!



1. 12:00 midnight Sunday: A huge Liberator Express, loaded with a secret cargo, roars down its California runway and soon dwindles to a speck on the horizon. The dispatcher checks off another routine flight for CONSAIRWAY, the military airline established in 1942 by Consolidated for the Air Transport Command.



2. 10:30 p. m. Tuesday: The ground crew at an Australian airport speedily unloads the Liberator's high-priority cargo . . . checks the engines . . . heaves aboard tons of mail for the U. S. A. A new "Pony Express" flight crew jogs out, climbs aboard, and the giant transport streaks down the runway for the return trip.

4. So far, CONSAIRWAY Liberators have made 1764 round trips between the U. S. and Australia—a total of 25,900,000 over-water miles, without a single fatal accident. The original Liberator that pioneered the Australia run has now completed 84 round trips and is still going strong!

5. Born of war, CONSAIRWAY's job, in the beginning, was to bring back Ferry pilots who had delivered bombers to the South Pacific. Westbound cargoes, today as then, consist of tons of spare aircraft engines and parts, medical supplies, and ammunition—in short, *any* supplies that are *needed fast* by our fighting men "Down Under."

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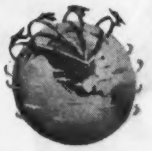
3. 11:20 p.m. Thursday: The Liberator contacts the control tower at its California airport . . . "CONSAIRWAY plane No. 10 coming in!" . . . and it's back home again. Since it left that same airport, 95 hours and 20 minutes ago, the land-based Liberator Express has logged 14,690 miles over the Pacific—to Australia and back!

6. After the war, long-range Liberator planes will continue to supplement other forms of transportation—the train, truck, and ship—in rebuilding the peacetime world. But airplanes will also have *another* role to fulfill: a permanent postwar Air Force can become America's soundest investment in the interests of a lasting peace.



No spot on earth is more than 60 hours' flying time from your local airport

From "Flying Jeeps" to Leviathans of the air — *The planes shown below were all designed and developed by Consolidated Vultee. When peace comes, the company will be in a position to provide the postwar equivalent of such planes, from small, privately owned "air flivvers" to huge, transoceanic cargo-and-passenger planes.*

LIBERATOR . . . 4-engine bomber

LIBERATOR EXPRESS . . . transport

CORONADO . . . patrol bomber

CATALINA . . . patrol bomber

VENGEANCE . . . dive bomber

VALIANT . . . basic trainer

RELIANT . . . navigational trainer

SENTINEL . . . "Flying Jeep"

QUICK FACTS FOR AIR-MINDED READERS

Atlantic "Millpond" — So far, during the war, Allied aircraft have flown more than 15,000 Atlantic Ocean crossings.

• • •

Life Saver—Probably one of the smallest warplanes in use, the famous Consolidated Vultee "Flying Jeep" has added a new job to its many other uses. Modified as a flying ambulance (*capacity: 1 litter*) it is speeding wounded men to base hospitals from small jungle clearings and other inaccessible spots.

• • •

Postwar "sky roads"—20,000 air strips, placed 10 miles apart in a pattern of squares, would cover the country. Adequately marked, they would enable the postwar small-plane owner to travel cross-country without learning a complicated system of navigation. Cost per strip: $6000 (*about ¼ the cost of 1 mile of national highway*).

• • •

"It is becoming increasingly clear to an air-minded America that a greatly expanded Air Transport, a permanent postwar Air Force, and a healthy, competitive Aircraft Industry will be important factors in helping to maintain a lasting peace and prosperity." Tom M. Girdler, Chairman of the Board, Consolidated Vultee Aircraft Corporation.

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There's a Big Swing to Less Common Metals

in "The POLLAK Version of Re-conversion"

No one will deny that production for war has substantially contributed to the techniques of design and manufacture of products from the lighter metals as well as the slower oxidizing metals.

But this skill and knowledge, born of war's necessities, can and will be turned to the advantage of the public through the manufacture of parts for peace-time products such as automobiles, refrigerators, washing machines, office appliances and the like.

This redesigning of parts and products utilizing stainless steels, Monel, Inconel and aluminum as well as steel and brass is an integral part of the Pollak Version of Reconversion. We are ready to pool Pollak techniques and experiences with these metals with the product planning ideas of engineers and sales staffs of American Industry.

The Pollak Version of Reconversion has already resulted in the redesigning and respecification of parts made of these metals for a number of products for consumer use! Our engineers and development experts may be able to help other firms modernize their products. Consultation invited without obligation.

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each operates and the advantages and disadvantages of each. Apparatus operating on direct current is compared with alternating-current devices with respect to performance, weight, cost, and maintenance. The latter part of the article outlines the benefits and difficulties of independent auxiliary engines as a source of electric power, compared with wind-driven and main engine-driven generators, and indicates that the present trend is toward the use of auxiliary engines in the larger types of airplanes. *Western Flying*, October, 1944, pages 88, 90, 92, 94, 6 illus.

Dimensional Studies of Lightweight Motors for Aircraft. Wayne G. Morrill. The writer points out how relatively complicated machines may be compared by a method similar to dimensional analysis for the purpose of establishing such relationships as output per pound or output per cubic inch. The effect of size on design properties is discussed. The properties of lightweight motors for aircraft are analyzed. Consideration is given to the basis for direct-current aircraft-motor study. *Electrical Engineering*, October, 1944, pages 698–701 (Transactions), 4 illus.

Engines

Mechanical Failures in Aero-Engines. W. N. Twelvetrees and K. W. Walpole. Typical design and production weaknesses in aircraft engines revealed by wartime operation are described. It is noted that the principal difficulty in the investigation of an engine failure is the complexity that results from secondary failures and the fact that similar effects can be produced from more than one cause. Basic factors that may be regarded as the most general cause of wartime engine failure are listed in the order of average occurence: (1) operational overloading and abuse; (2) "shock loading"; (3) enemy action; (4) "hydraulicing"; (5) defects in design; and (6) defects in material.

It is explained that "shock loading" occurs when the propeller strikes some fixed object and "hydraulicing" is a word used to describe the results of hydraulic pressure in the combustion chamber caused by a collection of oil or gasoline or both. Various kinds of defects and types of engine failures are described. Charts show the general relationship of the major causes of engine failure, and the relation of cause and effect in a typical complex failure. Micrographs and photographs reveal the defects in parts. *Aircraft Engineering*, September, 1944, pages 268–274, 18 illus.

Recent Research in Poppet Valve Train Design. Carl Voorhies. This article contains data on valve-train design derived from recent research projects. The usual problem confronting the engineer is the designing of a valve train that will provide as much power as possible with the torque curve required for the particular application, will have parts that are durable, and will maintain quietness of operation to a degree consistent with the application of the engine. Valve-train design by the trial-and-error method is discussed, and consideration is given to faulty motion, the major cause of which is stated to be excessive deflection. Methods of studying valve-train operation are given.

Four classes of instruments for studying the valve train are listed as: (1) equipment that measures the lift of the valve at selected positions of the cam so that the path of the valves in motion may be plotted; (2) oscillograph equipment that produces a picture of the lift curve, velocity, and acceleration curve; (3) a strain gauge that produces a graph indicating the loads on a selected part throughout the cycle, when used with an oscillograph; and (4) high-speed motion pictures. The use of the stroborometer for obtaining valve-motion curves is described. Consideration is given to cam design, theoretical and actual cam stresses, rocker-arm design, and the advantages of the hydraulic valve lifter, especially for air-cooled engines. *Automotive and Aviation Industries*, October 1, 1944, pages 92, 94, 96, 14 illus.

Civil Aircraft Engines. C. A. H. Pollitt. Criticizing the comments offered in a preceding article regarding the advantages of air-cooled engines for civilian aircraft, the writer takes up the case for liquid-cooled engines. He discusses the merits of this type of engine for high-powered civil air transports, particularly citing its adaptibility for "buried" installations. While questions of compactness and accessibility are also considered, weight advantage is another factor that is stressed. A comparative weight analysis between an air-cooled and a liquid-cooled power plant in chart form is used to define the superiorities of the latter on this point. *Flight*, August 31, 1944, pages 240, 241, 3 illus.

Engines for Private Planes. Carl T. Doman. In a survey of the powerplant requirements of postwar personal airplanes, the writer states that a fundamental need is the standardization of engine design and performance so that quantity production and reduced costs can be achieved. The problems of adapting aircraft-engine design to the quantity-production methods of the automotive-engine builders are outlined. Among the features believed to be imperative for engines for personal aircraft are means for preventing carburetor icing, dual ignition by either magnetos or batteries, and means for starting the engine without turning the propeller by hand. Costs are analyzed on the basis of a projected two-passenger plane to be sold, completely equipped for about $1,200, which would allow about $300 for the engine. Accessories such as a starter, generator, magneto or distributor, spark plugs, wiring, and carburetor could be of modified automotive type, costing about $30.

With a production rate of 100 engines per day, it is considered possible that a production cost of $100 for labor and material could be attained for a 100-hp. engine, but the desired weight limit of 100 lbs. is not believed to be feasible in the immediate future, it being more likely that the minimum will be around 200 lbs. Performance figures are given for engines ranging from 90 to 185 hp., with different propellers, comparisons are made between direct-driven and geared propellers, and a market is suggested for manufacturers of automotive transmissions through supplying standardized reduction-gear units for personal airplanes. Higher engine speeds are predicted, and different cylinder arrangements, using from four to twelve cylinders, are discussed. Other matters considered are fuels and cooling. The special problems involved in engines for helicopters are outlined. *Flying*, November, 1944, pages 51, 52, 106, 110, 3 illus.

Model Maintenance Plant. Canadian Wright Ltd.'s production-line techniques of engine overhaul are reviewed. Routines outlined include those of disassembly, cleaning, inspection and checking, replacement of worn parts, painting, and metallizing, reassembly, testing, and preparation for shipping. Information is also offered regarding the layout of the plant and the tools, jigs, and fixtures employed for the engine-overhaul procedures. *Canadian Aviation*, October, 1944, pages 139, 140, 143, 144, 146, 157, 13 illus.

The Gipsyqueen II. Part I. J. A. Oates. First of a series reviewing the methods employed for the manufacture of the de Havilland Gipsyqueen II. Part I contains a study of the engine's design features and an account of the machining operations that are performed on the crankcase, cylinder barrel, and head. Design and construction details are given on the cylinders, pistons, crankshaft, crankcase, camshaft, lubrication system, ignition, induction system, and starting equipment. The operations described include those of drilling, rough-boring, facing of the bearings, finish-boring, boring of the shells, and thread-grinding. In addition to particulars about the equipment used in these procedures, the article also offers a series of photographs and sectional drawings in illustration of the details discussed. *Aircraft Production*, October, 1944, pages 460–472, 31 illus.

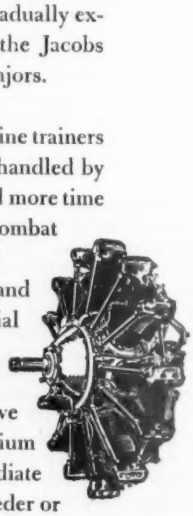
Device Indicates Powerplant Faults. Thomas A. Dickinson. A warning device for indicating the incipient failure of an aircraft engine is discussed in this article. Developed by the Consolidated Vultee Aircraft Corporation, this instrument is described as a deflection-indicating electrical limit switch that

"Until perpetual motion is here, gimme the Jacobs," says T/Sgt. Jinks. "I tended tea-kettles in this man's Army when they thought the JN-4 was a hot plane. I remember jobs that needed two hours in the shop for every one in the air. An' I'm here to tell you that this baby has fewer headaches and less hard work in it than any plane engine I ever met! You grease monkeys get a break because this outfit has Jacobs, and I want you to treat 'em right respectful—see?"

Technical Sergeant Jinks has almost as many hash marks as stripes and rockers on his sleeve. And when it comes to rating aircraft engines, his opinion is as good as they come.

Ground crews in training squadrons are powerfully partisan to the Jacobs. Three years ago, regulations specified 350 flight hours as the maximum service period between major overhauls. That period has been gradually extended to 1200 flight hours! And the Jacobs rarely leaves its nacelle between majors.

YET these Jacobs in the twin-engine trainers that school the bomber pilots, are handled by students, make more take-offs, spend more time at full throttle than any engine in combat service—or commercial operation!



This record of the Jacobs will stand the closest scrutiny of any commercial operation for low maintenance cost and dependable performance . . . After the war, Jacobs will also have new models for light planes and medium transports . . . well worth the immediate attention of plane manufacturers, feeder or freight line operators, private fliers . . . Jacobs Aircraft Engine Co., Pottstown, Pa.

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utilizes the torsional displacement of an engine caused by the propeller torque action against the resilient vibration-damping engine mountings. Whenever an engine begins to give trouble, the warning device causes a small light to flicker or glow over the feathering switch of that particular engine. A typical installation is photographically and diagrammatically illustrated. *Aero Digest*, October 15, 1944, page 94, 2 illus.

Flight Operations

Fuel Consumption. Lt. B. Orchard Lisle. A consideration of the problems attendant upon the work of the R.A.F. or U.S.A.A.F. petroleum service officer in projecting the amount of fuel which will be required by his unit for a given period. While the utility of gasoline-consumption tables is indicated, different factors are described which tend to make their accuracy variable. Some statistics are given on the volume of petroleum being consumed by British and American aircraft operating from the United Kingdom. *The Aeroplane*, September 1, 1944, pages 247, 248.

Should the Flying Control Officer Be a Pilot? Lt. R. G. Worcester. A discussion of the desirability of having a qualified pilot as the officer in charge of a control tower. While arguments against having a Control Officer who is also a pilot are considered, the conclusion is that the indicated advantages of pilot experience for the control job outweigh possible disadvantages. Attention is also called to the fact that flying control has now become scientific and specialized work. *The Aeroplane*, September 22, 1944, page 333, 1 illus.

Flight Testing

Lightplane Test Pilot. Paul H. Dietz. A test pilot outlines the specific checks that are made when the manufacturing firm flight-tests a light plane. His report briefly tells what is covered during routine production testing, experimental test flying, and demonstration flying for Army and Navy contracting officers. The purposes of the different kinds of flight tests are noted, as well as some of the problems commonly encountered during the tests. *Air Pilot and Technician*, October, 1944, pages 6, 7, 3 illus.

Fuels

Altitude Vapor Formation in Aircraft Fuel Systems. W. H. Curtis and R. R. Curtis. This paper describes an investigation of vapor formation in aircraft fuel systems at altitude. A series of tests were made with a simulated fuel system. This test equipment is described and illustrated. The results of five tests runs are listed. Some of the conclusions are: (1) The operation of a centrifugal fuel-booster pump properly installed will reduce the vapor potential of fuel on the discharge side of the booster. (2) The use of an electric-motor-driven fuel pump at any point in the fuel line between the fuel tank and the engine fuel pump has no effect upon the altitude at which vapor may appear in the carburetor, nor does it reduce its volume. Refinements in procedure and additional tests should permit the development of evaluation factors that will increase the usefulness of this technique. *SAE Journal*, October, 1944, pages 460–465 (Transactions), 14 illus.

To guard against the possibility of water in 100-octane gasoline, Douglas Aircraft Company employs this alternate static vent drain of transparent Tenite plastic in the fuel system of one of its planes. If any water should be present, it is automatically drained to this vent.

Studies of Fuels and Fuel System Phenomena Contributing to Aviation Vapor Lock. A. E. Robertson and R. Albright. It is pointed out that a small amount of vapor will cause vapor lock in aircraft fuel systems, and this trouble may even occur far below the boiling point of the fuel, especially when dissolved air is present in the fuel. Although the solubility of air in aviation fuel is not great, the vapor formation accompanying its evolution may be out of all proportion to the amount present. An equation is presented which makes it possible to predict the equilibrium amount of vapor that a gasoline will form for given initial and final conditions of temperature and pressure. With a knowledge of the temperature and pressure characteristics of a given fuel system, the vapor-liquid conditions existing throughout the system can be estimated in those cases where the initial condition of the fuel with respect to air saturation is known. *SAE Journal*, October, 1944, pages 466–471, 500 (Transactions), 7 illus.

Gliding and Soaring

The TG-3A. Ernest Schweizer. The writer discusses the design and development of the TG-3A two-place training glider, which was produced between July, 1942, and July, 1943. This glider is a development of the TG-2, which was built when the War Production Board limited the use of aluminum alloys to combat aircraft, and is basically similar to it. Information is given about the design of the component parts of this wood glider and the equipment used. It is noted that the landing gear construction is similar to the SGS2-8. *Soaring*, May-June, 1944, pages 8–10, back cover, 3 illus.

High-Altitude Flying

Altitude Chamber for Study of Heating and Air Conditioning Problems. W. E. Crowell. The writer describes some of the problems encountered in high-altitude flight and shows how the altitude chamber may be used to solve many of them. After describing the altitude chamber at the Curtiss-Wright Research Laboratory, the paper discusses the effect of altitude on man. The oxygen and temperature requirements of the human body are considered and some comments are made about aeroembolism and the effects of dry oxygen and air on the throat and nostrils. The effect of altitude on the equipment of the aircraft is then discussed in sections dealing with expansion and contraction, the viscosity of oils, electrical equipment troubles, and other problems. The latter part of the article deals with the heating of airplanes and pressurized cabins. *Heating, Piping & Air Conditioning*, October, 1944, pages 597–602 (ASHVE Journal Section), 6 illus.

History

The First Stratosphere Flight. Maurice Roddy. The story is told of the stratosphere flight made by Major R. W. Schroeder on February 27, 1920. Flying in a Liberty-powered Lepere equipped with a specially developed turbosupercharger, the Major is reported to have attained a height of 38,000 ft. In addition to being cited as the first stratosphere flight, this experiment is credited with having been responsible for another milestone in American aviation development. It is said that the good results obtained with the turbosupercharger for this flight caused appropriations to be made which permitted continuance of turbosupercharger research. A brief outline of Major Schroeder's aviation career supplements the account of the flight. *Southern Flight*, October, 1944, pages 38, 39, 76, 2 illus.

First Round-the-World Flight Made 20 Years Ago. An account of the first flight around the world, made by U.S.A. Army personnel between April 6 and September 28, 1924. Flying in Douglas Cruisers, the men are reported to have traveled a total distance of 26,345 miles in a total flying time of 363 hours, 7 min. The article contains a list of the flight personnel and what they are doing at present; a list of ground personnel who participated in the servicing of the aircraft at various stations; names of various newspaper-

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This power unit comprises a reservoir, electric driven pump and necessary valves, all completely self-contained. Quick-disconnect electrical plugs and self-sealing hydraulic couplings are provided. The unit can be located anywhere in the airplane and its operation electrically controlled from the cockpit.

Altair Electro-Hydraulic Power Units of this type have already been delivered and other designs are now being engineered for new airplanes. For any application where large forces must be quickly applied...precisely controlled, the basic advantages offered by this system include:

1. Increased efficiency, because of shortest possible fluid travel, minimizing pressure drop, plus the fact that the pump only operates when actual work is being done.
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A Technical Paper, presented before the November 10th meeting of Institute of Aeronautical Sciences, "Some Design Considerations of Electro-Hydraulic Power Supply Systems" is available to engineers who write for it on Company Letterhead. Pacific Division, Bendix Aviation Corporation, North Hollywood, California. Sales Engineering Offices in New York and St. Louis.

This Altair Electro-Hydraulic unit delivers 1 1/4 GPM minimum at 800 PSI. Overall dimensions are 10" x 11 3/16" x 16". Weight: 29 Pounds.

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men assigned to report the flight; and the route of the flight, together with the indicated number of statute miles between each landing point. *U. S. Air Services*, October, 1944, pages 19, 20, 40, 3 illus.

Correct Procedures for Tying Down Airplanes. Basic procedures are given for fastening airplanes securely to the ground when parked in open airfields. How reactions produced by the wind affect this procedure is explained. Information is supplied about the design and installation of concrete anchor blocks. Other types of tie-down anchors are described. A chart shows the various procedures for tying down airplanes and also illustrates certain methods to be avoided. *Aviation Maintenance*, October, 1944, pages 76–88, 184, 186, 12 illus.

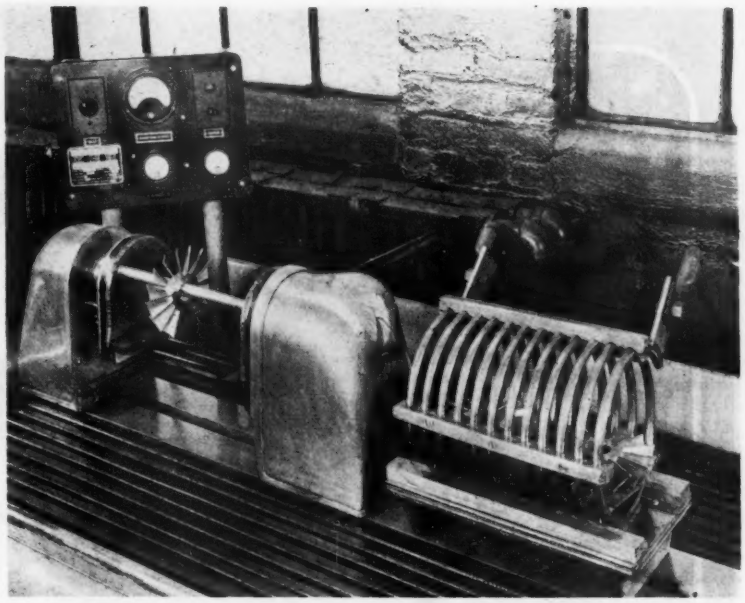
Inspection

How Filtering of X-Ray Beams Improves Radiograph Quality. Robert Taylor. Information is given about the use of metallic filters for altering the radiation to meet the varying conditions imposed by different metals and alloys in radiographic inspection work. Terms such as "hardness" and "depth-percentage intensity" are defined, and the effects of the interposition of filters on these properties are explained. Specifications are suggested for filters of the proper dimensions and compositions for inspecting different metal parts, as well as the technique required. The effectiveness of the filters is explained with the aid of reproductions of radiographs made with and without filters. Comments are given about the improved methods continually being developed in this field. *Aero Digest*, October 1, 1944, pages 88, 89, 214, 7 illus.

Measuring and Designating Surface Finish. Parts I and II. James A. Broadston. Parts I and II of a three-part article discuss the measurement of surface finish and describe a system of designation that clearly shows which surfaces are critical and which are not. The system permits the allowable roughness of critical surfaces to be defined in microinch units and is stated to provide an adequate means of controlling the surface quality of machined precision parts.

In Part I the writer reviews what has been common practice in designating surface finish and discusses types of surface irregularities and standards of roughness values. Consideration is given to surface terminology, the Root Mean Square microinch value, the R.M.S. microinch symbols, and the preferred roughness values.

Part II deals with measurements of surface roughness by the profilometer and the Brush analyzer. The use of the Amsler integrator to determine precise R.M.S. values from profile curves produced by either the taper section photomicrograph or the Brush analyzer record tape is described. *The Iron Age*, October 19, 1944, pages 62–66, 7 illus.; October 26, 1944, pages 76–81, 9 illus.; "Distinctive Symbol Adopted to Designate Surface Finish," by James A. Broadston, *Product Engineering*, October, 1944, pages 704–706, 5 illus.



A Magnaflux machine used for inspecting surface perfection of machine forgings at the Cadillac Motor Car Division of General Motors Corporation.

Planned Inspection Improves Quality Control. Herbert Chase. As employed by the Fort Edward plant of the General Electric Company, planned inspection procedures for obtaining quality control are outlined. Features of the system to which attention is called include the use of operation inspection tags; first-piece checks; special fixtures for the facilitation of measurements; and selective assembly aids in holding certain close limits. In addition to photographs of equipment employed in the checking processes, illustrations are shown of the paper forms that help to facilitate the work. *Wings*, November, 1944, pages 1276–1278, 9 illus.

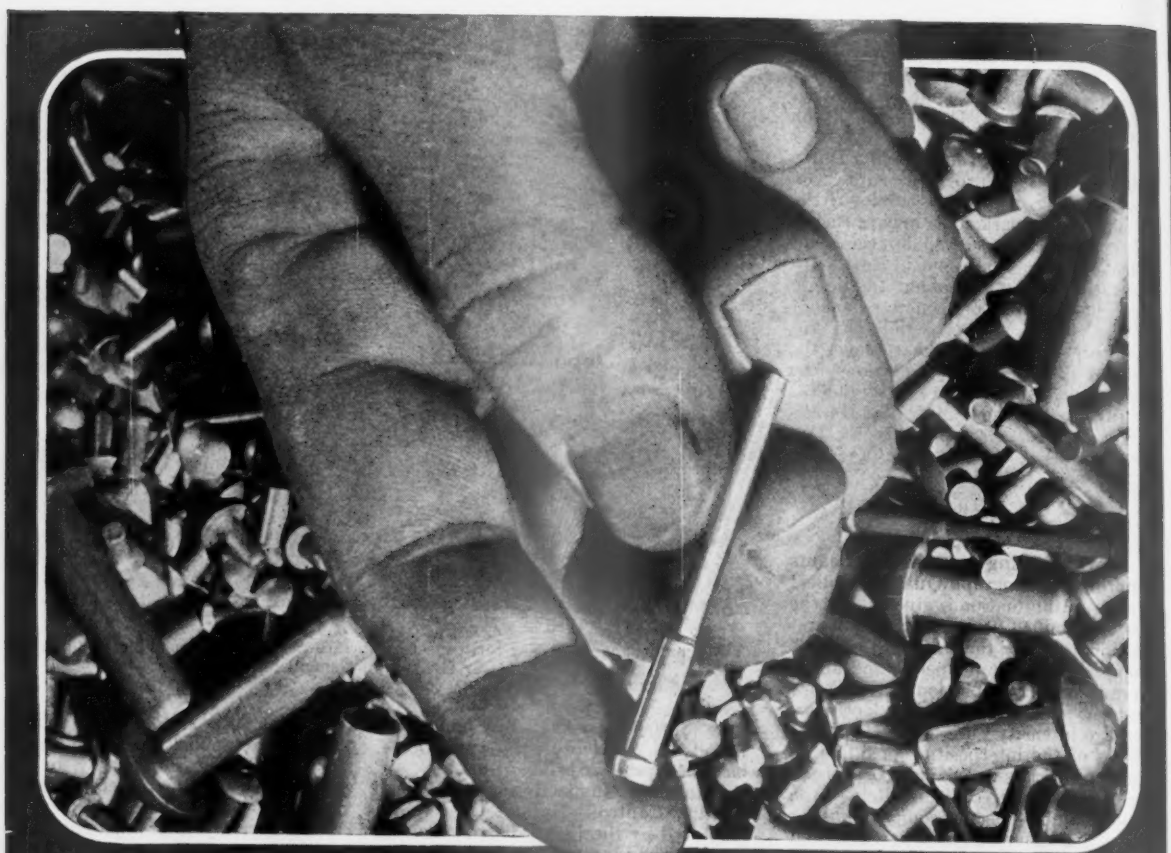
Inspecting Spot Welds by X-Ray. Robert Taylor. The spot welding of aluminum-alloy parts and X-ray methods of inspection are discussed. Sections of the article deal with the preparation of the sheet for welding, the electrodes, spot-welding machines, and X-ray inspection techniques. *Industrial Aviation*, October, 1944, pages 55, 56, 58, 102, 5 illus.

Instruments

Let's Make Instruments Flight-Like. Capt. Ken Lester. The design of flight instruments to picture the situations that they interpret is suggested and discussed. Explaining the advantages to be gained by such design revision, the writer analyzes the mental exercise that is required to interpret the indications of three different types of flight instruments: "fact" instruments, as typified by the altimeter; "symbol" instruments, as typified by the needle-ball assembly; and "attitude" instruments, exemplified by the gyro horizon. He then shows why reference to the attitude instruments is simpler than any others because they most nearly portray the apparent motion they are meant to report. The gyro horizon is named as the instrument that is the most flightlike of any, although suggestions for its improvement are included with specific suggestions for the improvement of other flight instruments. *Air Facts*, November, 1944, pages 19–28, 4 illus.

For Accuracy in Aerial Photography. A brief article describes and illustrates an improved lens collimator, especially designed by engineers of Fairchild Camera & Instrument Corporation for final testing of Fairchild aerial camera lenses after installation in the cameras. Its purpose is to give a photographic record of the resolving power of each lens for correct focusing. *Instruments*, October, 1944, page 613, 2 illus.

System for Indicating Positions of Landing Gear and Flaps. Details are given on the construction and operation of an indicating system that enables the pilot of an aircraft to ascertain the exact position of his landing gear and wing flaps at all times. Employing the selsyn principle of remote indication, the system is a compact one consisting of two basic parts—the transmitter and indicator. It is manufactured by the General Electric Company and is produced in two types: one is known as the "A-N, Two-coil D-C Selsyn System"; the other is known as the "Two-wire Two-coil D-C Selsyn System." With energy supplied from a 28-volt battery, the principle involved is to vary the current in two coils in the indicator, in some predetermined relation to the movement of the landing gear or flaps, by means of a brush mov-



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How-to-do-it information is contained in Alcoa's booklet, "Riveting Aluminum". Also available is the catalog "Standard-Screw Products" which contains weight and dimensional data on standard Alcoa rivets. Copies will be sent to you free. The sound motion picture, "How to Rivet Aluminum", depicts the making and testing of rivets, preparation of the work, the actual riveting and final inspection. This picture may be borrowed from the Motion Picture Department, ALUMINUM COMPANY OF AMERICA, 2142 Gulf Building, Pittsburgh 19, Pennsylvania.

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ing over a resistance bridge in the transmitter. Schematic drawings illustrate the mechanics of the system. *Aero Digest*, October 1, 1944, pages 80–82, 5 illus.

Needle, Ball, and Ripcord. Lt. (j.g.) Robert W. Duncan. Advice is given on how to use the turn-and-bank indicator to best advantage. Five possible positions of the needle-ball assembly are described, with notes to the pilot on how to correct each attitude to obtain proper straight flight. It is explained also how these corrections work when the plane is inverted and recovery to straight flight is desired. The recommendation that the pilot always translate the indications of the instrument to airplane attitude is stressed. *Air Facts*, November, 1944, pages 62–66.

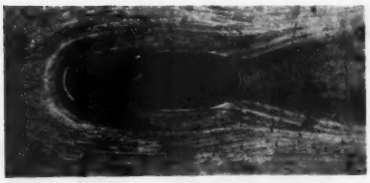
Electrically Operated Gyroscopic Instruments. H. Konet. This article discusses the electric gyroscope for aircraft instrumentation. Types described include vertical gyroscopes, the precessional gyroscope, the gryo-horizon indicator, the driftmeter, the gyro-roll indicator, the electric turn-and-bank indicator, the Gyro Flux Gate compass system, and the automatic pilot. Problems connected with production are considered. It is stated that for aircraft the electric gryoscope is rapidly supplanting air-driven types because of the following factors: (1) freedom from air-supply requirements at high altitudes; (2) sealing and elimination of air supply, thus preventing contamination and insuring greater reliability; (3) greater versatility, especially where electrical signaling devices are required; (4) compactness and greater reliability under extreme temperatures because of speed regulation and torque characteristics. *Electrical Engineering*, October, 1944, pages 735–738 (Transactions), 8 illus.

Landing Gear

Prerotation of Landing Gear Wheels. Henry F. Schippel. This paper describes the latest developments in one method of starting the landing wheels of aircraft to revolve before they make contact with the ground. The method discussed makes use of flexible vanes on the tires which cause them to rotate as soon as the wheels are lowered for a landing. An explanation is given of tests conducted to determine the position and angle of the vanes, the best operation of the landing gear, and the proper landing speed. A study of the airflow patterns is included. Results are tabulated and charted. *SAE Journal*, October, 1944, pages 486–491 (Transactions), 17 illus.

Lighter-Than-Air

In Rebuttal, on Behalf of the Airship. Hugh Allen. Extolling the qualities of the airship, this article is a reply to another article that appeared in a previous issue of the same magazine. In the earlier article four reasons were given for the writer's conclusion that he did not see promise of the early commercial practicability of the airship. In this article these reasons are contested. Testimony is given for the airship's ability to pick up and launch airplanes without slowing down, its ability to maintain flight schedules in spite of weather hazards, and the various factors of comfort and convenience which compensate for the airship's slower speed in comparison with airplanes. It is also affirmed that adequate terminal facilities for commercial airship traffic are already in existence, without necessitating the expenditure of huge sums of money. These are the Navy's blimp bases, which can be converted for commercial use. *U.S. Air Services*, October, 1944, pages 28, 41.



The airflow pattern around a B. F. Goodrich smooth-contour prerotatable landing-gear tire taken in a plane through the center of the axle. The photograph was of a 9-in. tire model at an air speed of 60 m.p.h.

Lubrication

Aircraft Lubricating Greases. R. S. Barnett, F. E. Tobin, and Gus Kaufman. Information is provided for the maintenance man regarding the lubricating greases required for the various parts of aircraft and the way to utilize and apply these lubricants to the best advantage. Following general remarks concerning the lubrication of antifriction bearings, specific instructions are given for the application of lubrication techniques to military and commercial aircraft. *Aviation Maintenance*, October, 1944, pages 56–59, 162, 166, 168, 170, 4 illus.

Maintenance

Job Procedures to Facilitate Repairs. This article discusses the application of production illustrations, supplemented by instructions for job procedures, to aircraft maintenance and repair. It describes an experimental study dealing with the development of production illustrations and job procedures for use in the Assembly and Repair Department of the U.S. Naval Air Station at Alameda, Calif., which was conducted by the Industrial Engineering Division. The study was confined to the installation of Bureau of Aeronautics fuselage changes in the OS-2U-1, -2, -3, and OS2N-1 airplanes. The procedures are explained at length and a chart is reproduced showing the combination of illustrations and instructions. *Aviation Maintenance*, October, 1944, pages 68, 69, 186, 188, 190, 192, 196, 198, 200, 202, 2 illus.

When It Rains. A. L. Jacobs. Naming components and accessories of an aircraft which are particularly susceptible to rain and dampness, the writer advises procedures for avoiding, checking against, and repairing the deteriorating effects of moisture upon an airplane. His suggestions refer to control cables, small hardware, ball-bearing installations, adjustable stabilizers, longerons and cross members, and wing coverings. Other items are engines and engine controls, cowling and fasteners, propellers, tail skids, landing-gear axles and tail-wheel assemblies, rubber bungee shock absorbers, oleo shock struts, external brace wires, and interior upholstery and wood trim. *Air Pilot and Technician*, October, 1944, pages 12, 13, 1 illus.

Aircraft Cleaning. Part II. Gilbert K. Brower. The concluding section of a two-part article describes the methods and equipment used in cleaning aircraft. The cleaning problems common to all air-transport operators are reviewed with regard to detergent materials used and procedure followed. Such problems include exterior cleaning of aircraft, cleaning of plane interiors, engine-parts cleaning after disassembly, paint stripping, and miscellaneous subjects such as oil tanks, spark plugs, preparation for plating, glass and plastics, etc. Types of equipment of interest to air-transport operators are discussed. These include blast-cleaning units; tanks, without equipment or equipped with means for heating, temperature control, agitation, ventilation, etc.; vapor degreasing; chemical or steam vapor cleaners; mechanized washing machines; and burnishing barrels. Consideration is given to the relative advantages of chemical and steam-vapor cleaning. *Air Transport*, October, 1944, pages 91, 94, 97, 1 illus.

How Landing Gear Service is Handled at Northwest Airlines. Ed. Parker. The highlights are given of service procedures at a specialized landing-gear shop where the landing gear of air-transport planes are inspected and overhauled. *Aviation Service Magazine*, September-October, 1944, pages 24–28, 9 illus.

Production Line Carburetor Overhaul. Paul F. Adair. The application of quantity-production methods to carburetor overhaul is described in this article, which deals with the procedure employed by Air Service Command depots. The successive steps in production-line overhaul are described and illustrated. *Aviation Maintenance*, October, 1944, pages 48–51, 148, 150, 154, 156, 158, 162, 40 illus.

Corrosion. Part II. Ray Sanders. This is the second of a series of articles on corrosion prevention, cleaning, and other problems connected with aircraft maintenance. Subjects discussed include: the chemistry of engine overhaul; the occurrence of electrolytic corrosion when certain dissimilar metals are immersed in the same cleaning solution; the preservation of chromate castings; cleaning solutions; and cleaning-solu-

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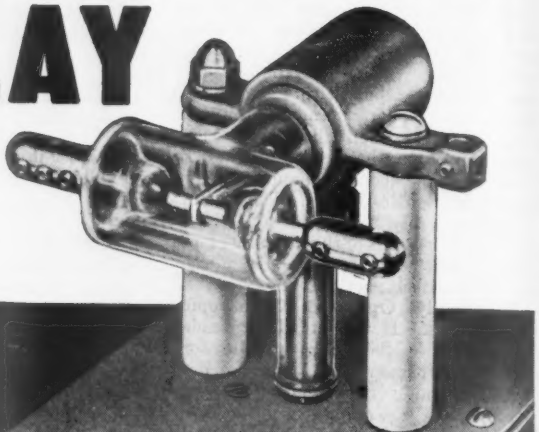

Here is convincing proof that a keying relay does not have to be complicated to be efficient. In fact, just the reverse! Actually, the extreme reliability with which Struthers-Dunn Type 78CCA100 Relay holds its adjustments is the direct result of its new simplified and rigid design which utilizes an absolute minimum of parts.

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tion control. *Air Tech*, November, 1944, pages 28–30, 72, 7 illus.

Management

Weight as the Key to Waste Control. Raymond A. Nathanson. Lockheed Aircraft Corporation's method of using weight as a basis for indicating the percentage of scrap generated by any fabrication operation is explained. Various investigations conducted by the Conservation Department to establish this means of waste control are reviewed, and the paper forms employed for the recording of scrap percentages are described. With the Sheet Metal department as an example, it is demonstrated how reports are made on the amount of material orders entering the department; the weight of these orders at the time of entrance; the type of material; the scrap generated from each alloy at each operation; the material rejected because of damage; the sweepings generated in the section; the mixed borings in the section; and, finally, the percentage of scrap as figured from a compilation of the foregoing elements. *Aero Digest*, October 1, 1944, pages 117, 118, 212, 4 illus.

Marketing

How Will Postwar Planes Be Sold? James A. Wales, Jr. Three postwar distribution plans are outlined for the aircraft manufacturer. In each plan the factor of adequate control is stressed. Primarily, this factor is interpreted as the establishment of standard sales and service facilities at major sales outlets, with predetermined standard charges made for certain service and overhaul jobs. However, it is also described as including the standard training of salesmen and the uniform physical appearance of various merchandising material, such as signs and posters. The value of a well-planned system in reducing distributing costs and promoting the sales of planes is indicated.

The three plans are called a Dealer Plan, a Distributor Plan, and a District Sales Office Plan. The first involves the appointment of direct factory dealers by the manufacturer's sales manager. It features bringing the dealer into the plant for an intensive training course in the design, construction, and maintenance of the airplane he is to sell; giving him a complete sales course; and schooling him in the company's standard accounting and general business procedures insofar as they will affect his own operations. The Distributor Plan is similar to the Dealer Plan except that the territories are larger and the quotas are proportionately higher. Each distributor has several dealers working directly under him in preassigned subdivisions of his own territory. The third plan calls for the operation of the dealers under the supervision of branch offices and warehouses, one to a district, managed by the district manager. Under this system the district man is, in effect, a large distributor, except that he is an employee of the manufacturing firm and not in business for himself. *Aviation*, October, 1944, pages 124, 125, 270–277, 3 illus.

Programming of Aircraft Parts Distribution and Service. Franklin M. Reck and Edward L. Warner. This survey of the postwar plans of various aviation and automotive companies shows an existing basis for an expansion of parts distribution and airplane service. It takes into consideration the channels and methods by which engine companies, manufacturers of engine parts, makers of engine and aircraft accessories, wholesale distributors, and local dealers expect to offer their aircraft products and services to the public. Figures are quoted from a recent survey made by the Automotive and Aviation Parts Manufacturers Association indicating the extent to which new companies have entered the aircraft-parts business during the war and the number who intend to stay in the airplane business after the war. The questions of how far automotive-parts distributors want to share in the aircraft-parts business and how many automobile dealers will want to sell a line of airplanes are touched upon. Attention is also called to the need for simplification and standardization of many aircraft supplies and parts. *Aero Digest*, October 15, 1944, pages 75–77, 150, 152, 3 illus.

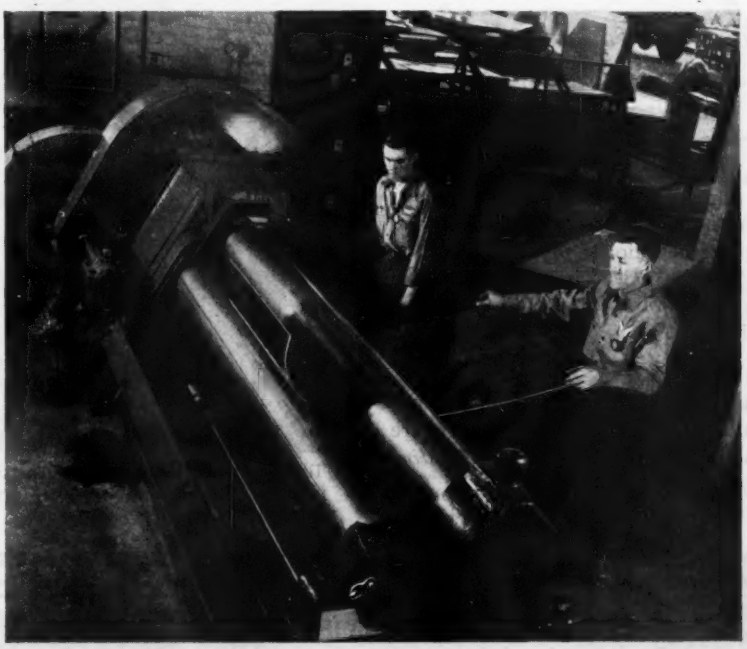
Materials

The War's Foremost Achievements in Materials and Methods. Edwin F. Cone. A report is given of a survey made with the object of obtaining a coordinated appraisal of the metallurgic achievements in the development of new materials and methods resulting from the war effort. The opinions of many well-informed men regarding generally known developments are summarized. Sections of the article discuss the light metals, the NE steels, high-temperature resisting steels, boron in steel and iron, achievements in the foundry industry, powder metallurgy and carbon tools, and other developments. Ten leading wartime engineering materials and methods of development are outlined. *Metals and Alloys*, October, 1944, pages 916–921, 4 illus.

Delignified Impregnated Wood. Foster Luce. This article discusses the delignification of wood, which, it is explained, is the treatment of wood chemically with heat and pressure before the veneer layers are impregnated or bonded. Details are given about the delignification and impregnation processes. How papermaking technique has been borrowed for the process is described. Other sections of the article discuss impregnating materials and the kinds of wood that may be treated. *Mechanical Engineering*, pages 654, 655, 657.

75S-Alcoa's New High-Strength Aluminum Alloy. J. A. Nock, Jr. An engineering analysis is made of the nature, properties, workability, and applications of 75S aluminum alloy. The subject is treated in sections dealing with the mechanical properties and heat-treatments, formability, resistance to corrosion, and joining. Tables and graphs give the mechanical properties. *Metals and Alloys*, October, 1944, pages 922–925, 6 illus.

High-Strength Centrifugal Castings. Stanley P. Perry. A brief description is given of recent research that has resulted in centrifugally cast steels having a tensile strength of 180,000 lbs. per sq.in. and a ductility of 10 per cent. The process of casting such



Roll forming of sheet metal at a plant of the Reynolds Metals Company.

steels is outlined. A table gives a comparison of the mechanical properties of centrifugally cast and wrought pierced steel tubing. *The Iron Age*, October 5, 1944, pages 52, 53, 3 illus.

R301—Reynolds' New High-Strength Aluminum Alloy. T. L. Fritzlen and L. F. Mondolfo. A technical description is given of the composition, properties, and treatment of R301, a new Clad material consisting of a high-strength core alloy clad with a medium-strength corrosion-resistant alloy. The material was developed to meet the needs of the aircraft program. Tables contain data on the properties of the material, solution, treatment times, heat-treatment times, aging times, etc. Micrographs of the material are reproduced. *Metals and Alloys*, October, 1944, pages 926–933, 28 illus.

Adhesives for Metals and Nonmetals. Kenneth Rose. The writer classifies and describes the most important cements developed for joining metals to each other or to nonmetallic materials such as wood, plastics, rubber, and glass. The present and future uses, possibilities, and limitations of these adhesives are discussed. *Metals and Alloys*, October, 1944, pages 959–963, 5 illus.

Medicine

A Comparison of Altitude and Exercise with Respect to Decompression Sickness. S. F. Cook, O. L. Williams, W. R. Lyons, and J. H. Lawrence. A study of the comparative effects of altitude and muscular exercise upon decompression sickness. The conclusion reached is that an increase in altitude from 30,000 to 38,000 ft. increases the incidence and severity of decompression sickness considerably more than does an increase in the muscular work of a subject.

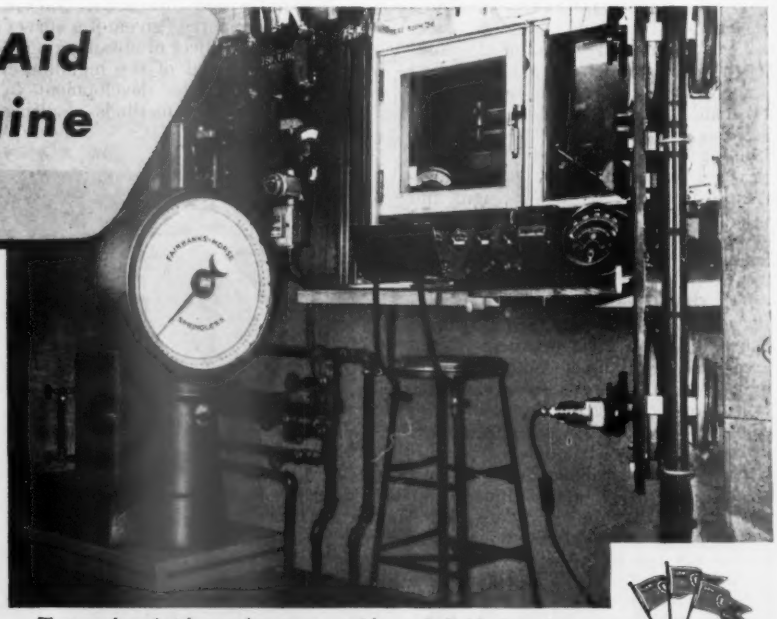
The experiment was conducted by giving four groups of healthy young men (ages 18 to 20) two chamber tests each. One group was taken to the equivalent of 30,000 ft. and performed a standard exercise every 5 min. for 90 min. The second group performed the same exercise every $2^1/_2$ min. at this simulated altitude. The third group was taken to 38,000 ft. and performed the standard exercise every 5 min., and the fourth group performed the exercise every $2^1/_2$ min. at 38,000 ft. Criteria used to compare the bends-inducing effect of the four sets of conditions consisted of per cent incidence of symptoms, per cent incapacitation, time of onset of symptoms, time of descent, maximum intensity of symptoms, and velocity of development of symptoms. All criteria are reported to have shown statistically significant differences between the two altitudes with constant exercise. When altitude was held constant at 30,000 ft., the effect of doubling the frequency of the standard exercise was relatively slight and not in all cases of statistical significance. At 38,000 ft., the effect of increase of exercise was significant with most criteria, but much less pronounced than the effect of changing altitude. *War Medicine*, September, 1944, pages 182–187.

Meteorology

The Use of Cross Sections in Briefing Away Traffic Controllers. Emil S. Kurtz. It is stated that since the establishment of the Flight Advisory Weather Service, the usefulness of cross sections has been demonstrated in portraying significant cloud and weather phenomena along the airways to pilots and Airway Traffic Control personnel. It is explained that the purpose of the particular type of cross sections being employed in F.A.W.S. centers is, primarily, to help the Advisory Meteorologist convey to the Airway Traffic or Army Flight Controllers a clear picture of existing weather conditions along the airways in the control area. The general procedure for the construction of cross sections is described. *Bulletin of the American Meteorological Society*, September, 1944, pages 307–310, 2 illus.

Service Flyers Brave the Hurricane. Capt. Burr Leyson. From the experiences of Navy and Army air crews in locating and tracking the recent hurricane, which swept the Eastern seaboard of the United States, the effects of such weather disturbances upon air-transport operations are reported. It is stated that hurricanes present no obstacles to long-

Scales Aid Plane Engine Testing



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Test engineer's observation post outside an individual engine test cell, showing the Fairbanks-Morse Scale and the gauges which indicate engine performance.

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Pistons for Air Compressor
Pins for Air Compressor
Piston Rings for Air Compressor

LANDING GEAR PARTS
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Piston Rings
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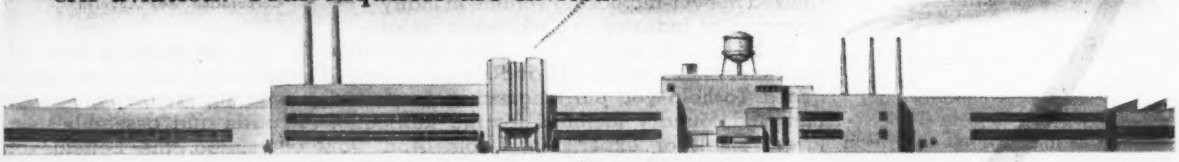

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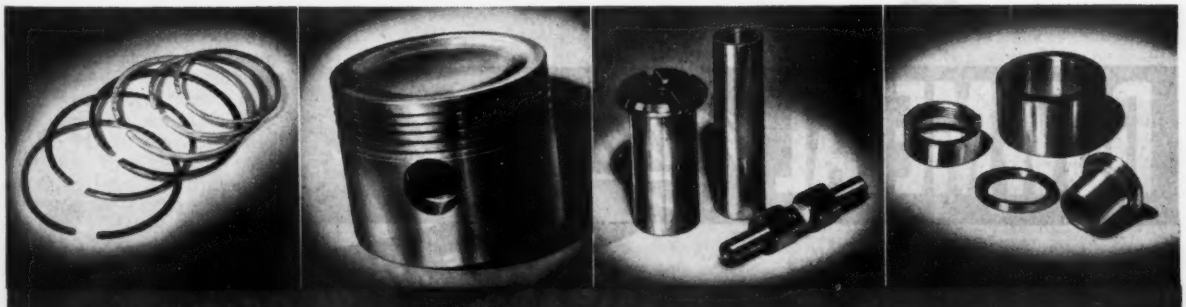

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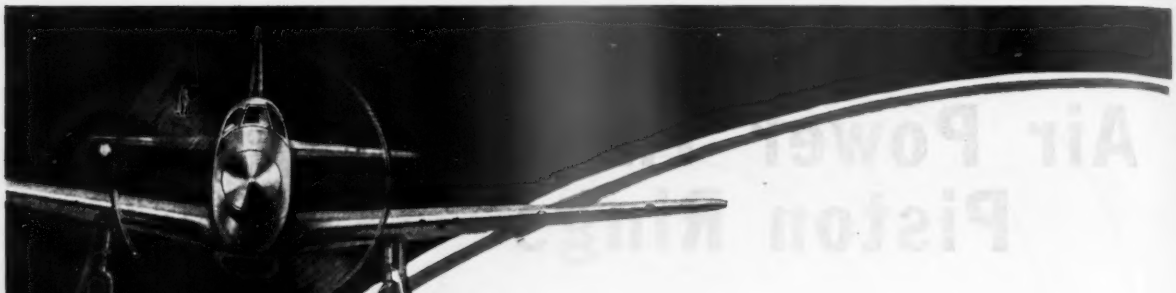
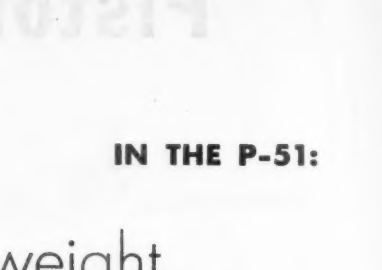


IN THE P-51:

Magnesium saves weight in the speedy Mustang Fighter

There are several reasons why the North American P-51 Mustang has a speed of 425 miles an hour . . . why it has such a broad range . . . and a ceiling of more than 7½ miles: ingenuity of design; precise accuracy of parts; skill of assembly; and the thorough testing and wise selection of materials.

One of these materials is magnesium. Durable, strong Dowmetal Magnesium Alloys, the lightest of all structural metals, contribute substantially to the performance of the P-51, just as they make possible greater speeds and efficiencies in other types of aircraft.



One of many magnesium parts in the P-51 is this 46-pound main landing gear pivot, cast in permanent mold by Century Metalcraft Corporation, Los Angeles.

Dowmetal Magnesium Alloys are being utilized in ever-increasing volume in many branches of industry . . . wherever metal is to be put in motion . . . in transportation . . . in the moving parts of machinery . . . in hand- and power-operated equipment, tools and appliances. To help you put magnesium to work, Dow maintains complete shop, mill and foundry facilities for the fabrication of parts and assemblies, in large, small or experimental lots. And Dow offers, too, the benefits of experience and knowledge afforded solely by magnesium's pioneer producer and fabricator.

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range air-transport operations except when they blanket bases. On the contrary, it is indicated that storms of that type may be used to the advantage of the operation by speeding its performance. However, in the case of comparatively short hauls, hurricanes are reported to have adverse effects upon maintenance of schedules since the distances do not permit detouring the storm, and landings are made virtually impossible.

Wind, sea, and visibility conditions during the experiments are described. It is noted that the air crews are able to enter and leave the storm at will, while the turbulences encountered offered no danger to the structure of the aircraft. *Aero Digest*, October 15, 1944, pages 60, 156, 157, 1 illus.; "Army Flyers Buck 125-Mile Wind and Upset Textbook Theories," *U.S. Air Services*, October, 1944, pages 24, 36.

Weather Briefing. This article describes a method of visual presentation of weather information used by a division of the Army Air Forces in Europe. It consists of a three-dimensional model based on a topographic map of Europe, in which plate-glass slides represent vertical cross sections depicting atmospheric conditions. An explanation is given of the functions of the device and its use in planning the operations of the Eighth and Fifteenth Air Forces. *Air Tech*, November, 1944, pages 34, 35, 4 illus.

Military Aviation

The Truth About the Fw. 190. P. H. C. Based on the experience of British pilots in combat, this article discusses the performance of the FW 190 and compares it with that of the Spitfire. It is concluded that the FW 190 has good qualities as well as defects, and both it and the Spitfire are near perfection according to today's standards. *Aeronautics*, October, 1944, pages 34, 35, 5 illus.

Fighter Range Chart. A system of quickly ascertaining the specifications of various Allied bombers and fighters is given with two "cut-out" charts. With these charts, when assembled concentrically, the function, maximum speed, normal range, range with drop tanks, and bomb load can be determined for the listed American, British, and Russian combat aircraft. *Skyways*, November, 1944, pages 36, 37, 2 illus.

The Allocation of German Type Numbers—II. A continuation of the list of type designations of German military airplanes since 1933 ranges from the He 112 to the ZSO 523. The information includes the name of the maker, a brief description of the aircraft and the purpose for which it was designed, and the type of power plant used. *The Aeroplane Spotter*, September 21, 1944, pages 221, 226.

The Unknown Battle. Charles J. V. Murphy. A graphic review is given of how American warplanes lessened the effectiveness of German air power in five great sky battles fought during a week in February, 1944. These actions are stated to have cleared Europe's skies preparatory to the invasion. The difficulties encountered in destroying German industrial and military targets before these battles were fought and Germany's air strength was broken are described. Illustrations show how the five battles were carried out. *Life*, October 16, 1944, pages 97–110, 10 illus.

Fighters of the Future. Designs suggested by several artists specializing in portraying aircraft are pictured, with brief explanations. It is stated that engineers have examined these suggestions for hypothetical aircraft and have reported that the designs are not only plausible but are, perhaps, an immediate possibility. Jet and rocket propulsion, "flying wing" craft, pilotless fighters, and superbombers are included, as well as advanced ideas in armament and gliders. *Skyways*, November, 1944, pages 38–51, 19 illus.

Paints and Coatings

Infra-Red Lamp Applications. This article deals with an infrared lamp installation developed by General Electric Company, Ltd., for drying the paint on large aircraft-engine castings. It not only describes the installation but also indicates its advantages over conventional type electric ovens. The report is that, with the lower temperatures reached during infrared lamp heating, risks of damaging the painted surfaces are reduced and all machining may be completed before painting. Further advantages claimed for the system are a saving of 10 per cent in electric power consumption and a 75 per cent reduction in stoving time. Applications are for components up to 2 ft. in diameter and weighing more than 200 lbs.

Mention is also made of two other applications of the infrared heating process. The first is for softening plastic sheets and the second is a medium for drying Polythene and other powders. *Aircraft Production*, October, 1944, page 459, 1 illus.

A Surface Finish for Magnesium Alloys. N. H. Simpson and Paul R. Cutter. Details are given on an anodizing method for coating magnesium alloys which has been developed by two Consolidated Vultee Aircraft Corporation chemists. Known as the CVAC No. 1, AC, or CVAC No. 1, DC, the technique is said to produce film that inhibits corrosion, resists abrasion, and forms a tight, integral bond with paints.

The application of the process is described as follows: After being properly degreased, the magnesium parts are placed in the alkaline electrolyte where they are made the cathode for electrocleaning with a direct current. This removes the manufacturer's chrome pickle film and prepares the surface for the anodic finish. If direct current is to be employed in producing the new finish, the current is merely reversed and the work made the anode. If the a.c. finish is desired, the magnesium parts are connected to a low voltage a.c. transformer after electrocleaning. After anodizing, the parts are rinsed in hot water to remove excess caustic from the surface of the finish. The parts are then immersed in a warm, weak chromic acid solution for several minutes to neutralize properly any remaining alkalinity and to brighten the anodic surface. The parts are then dried and sealed by dipping them in a highly-thinned solution of zinc chromate primer or its equivalent.

It is claimed that this anodizing process comes much closer in every respect to meeting the demands of an ideal finish for magnesium alloys than existing commercial finishes. The fact that two coats of paint are sufficient for proper insulation offers a saving in weight, while the chemicals and electrical equipment required are stated to be comparatively inexpensive. *The Iron Age*, October 5, 1944, pages 54–58, 5 illus.; "Anodize Method for Magnesium Alloys," N. H. S. Simpson and Paul R. Cutter, *Southern Flight*, October, 1944, pages 66, 68, 70.

Parachutes

Cheaper, Lighter, Tailored Chutes Seen for Post-War Private Flyer. Alexander McSurely. Discussing probable developments in parachutes for the private flier, the writer predicts that synthetic textiles and advances in preservation methods will result in marked improvements in quality and performance and also in a reduction in price. Subjects considered include moistureproof sealing, the use of Nylon webbing for the harness, and the improvement of parachute stability. *Aviation News*, October 30, 1944, pages 21, 22.

Personalities

Philip Gustav Johnson. Some highlights in the course of P. G. Johnson's affiliation with the aviation industry are recounted. The notes pertain to his early career with the Boeing Airplane Company and his work as President of the Boeing Airplane Company and Boeing Air Transport (later changed to United Aircraft and Transport Corporation), as organizer of Trans-Canada Air Lines, as wartime President of the Boeing Aircraft Company, and his part in helping to develop Boeing planes and aeronautical transport activities. Interspersed with the recollections about Mr. Johnson is a record of the growth of the Boeing company and explanation of the division of United Aircraft and Transport Corporation into three separate units. *U. S. Air Services*, October, 1944, pages 22, 23, 36, 2 illus.

The Gray Haired Ensign. Lawrence E. Watkin. Vice-Adm. Aubrey Wray Fitch, Deputy Chief of Naval Operations for Air, is the subject of this biographical article and character study. Although the Vice-Admiral's career with the U.S. Navy is outlined from the time of his experiences as a gunnery officer during the first World War, the major portion of the review is

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concerned with the role he played in the Solomons campaign of this war. He is credited with having coordinated the combat flying of U.S. Army, Navy, Marine, and New Zealand aviators throughout the campaign. *Flying*, November, 1944, pages 49, 118, 122, 126, 130, 1 illus.

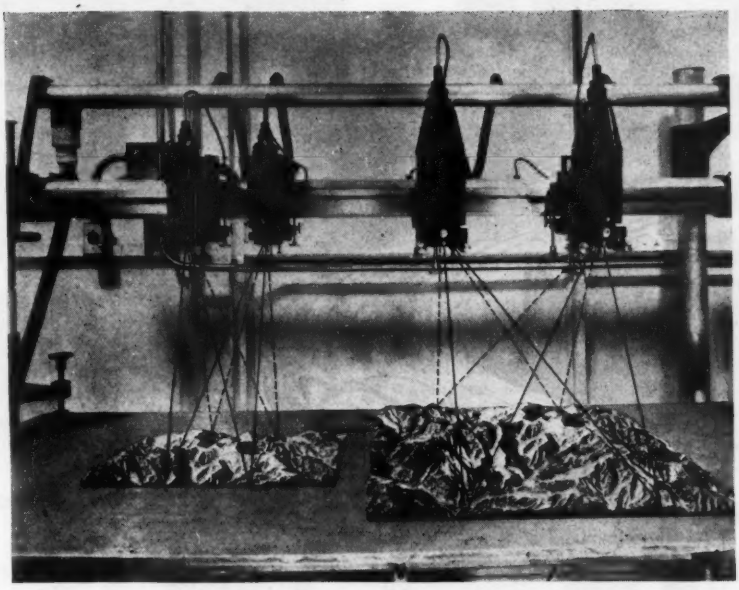
Youth, Unlimited. Howard Waldorf. This article tells about Stanley Hiller, Jr., the young man who invented the Hiller-copter, a coaxial helicopter. It outlines, with quotations from the inventor, the many problems that had to be met in the development of this aircraft. The testing of the experimental model is described. *National Aeronautics*, October, 1944, pages 15–17, 20, 3 illus.

Personnel

Your Postwar Aviation Job. Lt. (j.g.) L. W. Burton, Jr. Second in a series of articles investigating career possibilities in the aviation field after the war. This article is concerned with the jobs that will be available in airport management. Different types of airports that will require administrators, varied qualifications for such jobs, and the salaries they will command are discussed. A brief review is included of secondary jobs that will be available in connection with airport operation. The point is emphasized that previous association with aviation will not be a major qualification for airport managers or their assistants. *Flying Aces*, November, 1944, pages 26, 27, 70, 72, 6 illus.; "Ward Heller in Command of Ocean Liner," by Jerome C. Lederer, *Airports*, September, 1944, pages 23, 44, 1 illus.

Photography

Photographic Materials for Aerial Photography. Walter Clark. Improvements that have been made in aerial films and other photographic materials are reviewed. It is noted that about 1930 research on sensitizing dyes developed very actively and a few years later discoveries of great importance were made. At the same time, there was being carried out active research on the methods of making the sensitive emulsions themselves, and the progress in this field, coupled with the advances in knowledge of sensitizers, led to rapid improvements in films of all kinds, including those for aerial photography. As far as the negative is concerned, these advances were evident from shortened exposure times, greater control of contrast, improved response to red light, higher resolving power and lower graininess for increased speed, low fog and improved keeping properties, and the ability to make films particularly sensitive to special spectral regions. Types of film utilizing the new discoveries are described. A table shows the speed and resolving power of the types of aerial film for black-and-white photography which have been made during the past 10 years. Another table gives the approximate shrinkage characteristics of Kodak aerofilm and topographic acetate sheeting. *Photogrammetric Engineering*, July-August-September, 1944, pages 132–135.



U.S. Army Air Forces photograph

Model showing the overlap of the projected images in the Bausch & Lomb Multiplex projector.

Aerial Cameras and Photogrammetric Equipment: A Quarter Century of Progress. Revere G. Sanders. The progress made in aerial cameras and photogrammetric equipment during the past 25 years is reviewed. The article has particular reference to equipment produced by the Fairchild Camera and Instrument Corporation. It is noted that it was the emergency of World War I that brought out the K-1 aerial camera, the K-2, and, in 1918, Sherman Fairchild's K-3 with intervalometer and between-the-lens shatter. Civilian surveyors were cautious, however, and considerable time elapsed before the value of the new aerial method was generally recognized. During those years the mapping needs of the country were of the kind that could be taken care of well enough with existing equipment and methods to satisfy general purposes. Thus, no incentive existed for radical changes or developments in this line. It is stated that aerial surveying might have remained at a standstill had it not been for the help of military and naval organizations, the solving of whose special problems brought about developments that might never have taken place had they depended on the initiative of purely peacetime functions. A section on single-lens cameras discusses modifications that were made in the K-3 and describes other single-lens cameras that were developed. Other sections discuss developments in multiple-lens cameras and plotting devices. *Photogrammetric Engineering*, July-August-September, 1944, pages 136–159, 35 illus.

Want a Job? Jack Hamilton. This is an examination of the postwar career possibilities in the specialized field of photogrammetry as allied to aviation. An explanation of the science defines it as involving four basic elements: flying the photographic mission, processing the film, compiling maps from photographs, and interpreting them as to the particular knowledge desired. Interpretation of the application of these functions to peacetime needs indicates some of the jobs that will be opened to qualified men in the photo-map-making field after the war. The question of who will have the business and authority of supplying surveys and maps to meet the demand is also considered. Information is largely based upon a digest of the predictions made at a recent meeting of representatives of commercial mapping agencies and from photographic services in the Army, Navy, and Marines. *Skyways*, November, 1944, pages 30, 31, 78, 5 illus.

Ten Years of Progress in Photogrammetry in the Corps of Engineers. Major A. W. Kendall. To illustrate the progress in photogrammetry made by the Corps of Engineers during the past decade, the writer presents a brief review of the operations of the Twenty-Ninth Engineers Topographic Battalion during that period. *Photogrammetric Engineering*, July-August-September, 1944, pages 161, 162.

Aerial Photography with the Navy and Marine Corps. Walter L. Richardson. In this review of the progress made in aerial photography in the Navy and Marine Corps, the early history of the subject is first discussed. The progress from 1934 to 1944, a decade of activity, is then outlined. The writer describes the photogram-

GOOD FOR TWENTY-FIVE DOLLARS ANY SUNDAY

● Farmer Jones could count on at least twenty-five extra dollars any summer Sunday in those good old days . . . hauling out the cars which, one by one, chugged and panted to a helpless standstill in the mudhole in front of his place.

But the cars which whiz along countless country highways nowadays are untroubled by mudholes, hills or rough going. Luxurious, dependable and safe, they are the products of an amazing quarter-century of automotive progress and of the initiative, vision and tremendous energy of the men in this youthful and dynamic industry.

The Eaton organization, by supplying mass-manufactured precision parts for many makes and models of cars, has done its best to contribute to that progress . . . to the development of the modern automobile and of the production methods which made it possible to build such *quality* into cars which rolled off the assembly lines by the hundreds or thousands every day.

The new knowledge and new techniques developed by Eaton in working with automotive and aircraft engineers during the war, have added greatly to the value of Eaton's thirty years' experience with these industries. After the war is completely won, everything that Eaton has in ability, experience and resources will again be devoted to peacetime progress in motor vehicles and aircraft.

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SUPPLIERS OF FINE PRECISION PARTS TO THE AUTOMOTIVE AND AIRCRAFT INDUSTRIES FOR MORE THAN THIRTY YEARS

metric equipment and technique in use by the hydrographic office, research and development work, training, combat aerial photography, and photographic interpretation. *Photogrammetric Engineering*, July-August-September, 1944, pages 163–167.

The AAF's Contribution to the Advancement of Photographic Mapping and Charting. Col. Jerald W. McCoy. This article describes the development of aerial photography as employed by the Army Air Forces for map- and chart-making purposes during the past 10 years. To present the picture in its proper perspective, some of the early phases of photography are first described. *Photogrammetric Engineering*, July-August-September, 1944, pages 168–172.

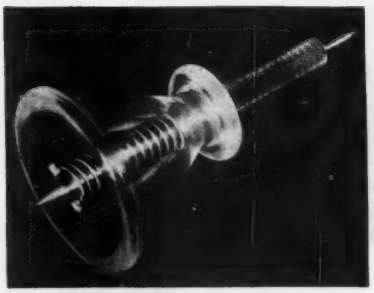
Plants

Controlled Air Conditions for an Airplane Plant. A D. Engle and W. W. Frankfurt. Design features of the air-conditioning system for the windowless plant of the Douglas Aircraft Company, Inc., in Oklahoma are described. To insure a minimum of difficulty in future replacements and maintenance and also to expedite the delivery of the equipment, the designs for the air-conditioning systems and other mechanical facilities were developed around standard units as far as possible. *Heating and Ventilating*, October, 1944, pages 60–62, 5 illus.

Plastics and Plywood

Bullet-Checking Plastic for Pressure-Plane Glazing. G. M. Kuettel. This article deals with the design variables and problems involved in developing transparent plastics for pressurized plane cabins which, when pierced by a bullet, will confine shattering to the smallest possible area. It also contains information about a new laminate for such installations. The laminate is Lucite-Butacite, consisting of a layer of Butacite polyvinyl butyral resin sandwiched between two layers of Lucite methyl methacrylate resin. Details are given relative to the characteristics, mechanical properties, fabrication, methods of attachment, and strength factors of this material. Results are reported of a series of tests comparing the laminate with similar structures in solid acrylic and conducted on semi-cylinders, domes, and flat glazing at various temperatures, pressures, and manners of gunfire.

In summarizing the problems involved in designing glazing for pressurized aircraft, they are classified broadly into three parts: (1) Design of attachment—eccentricities in loading must be avoided; the load should be applied equally to both faces of the plastic; attachments should be chosen which will not necessitate breaking the surfaces of the plastic, as in routing or drilling. (2) Design of glazing—careful thought must be given to the fatigue characteristics of plastics, since, in pressurized planes, they become a part of the primary structure. (3) Resistance to gunfire—if it is necessary to pressurize a military plane, then it is equally important to choose a plastic material that provides the greatest insurance against rupturing when the plastic is penetrated by bullet or flak. *Aviation*, October, 1944, pages 153–158, 20 illus.



One of the latest applications of Plexiglas is a bell cap center punch, used in aircraft construction for centering holes in template work and for providing a drill point at the necessary 90° angle to the surface. Developed by the Curtiss-Wright Corporation, this bell cap permits the operator to position the point visually.

Casting Plastics for Master Molds. L. R. Miller. Among the new tools recently produced at Northrop Aircraft was a plastic master model, the development of which is described.

The material used in this application was a phenolic cast resin manufactured under the name of Phenocast. How the plastic master model overcame difficulties encountered when a mahogany master was used for fabrication is described.

It was found that the plastic master maintained tolerances, saved fabrication hours, was durable, and eliminated subsequent rework. It is stated that a comparative test showed the overall cost of a plastic master to be approximately one-tenth of the cost of masters fabricated from mahogany. *Plastics*, November, 1944, pages 60, 61, 103, 5 illus.

Phenolic Laminated Sheet for Low-Pressure Hot-Forming. Information is given about a new technique of "postforming" thermosetting laminated sheet into shapes like deep-drawn or formed sheet-metal pressings. This material is being used in the fabrication of aircraft parts. A modification in the resin formulation which improved the forming qualities of the material is described.

Illustrations of typical formed parts are shown and details of the simple forming method are given. *Product Engineering*, October, 1944, pages 674–678, 6 illus.

Powering a Rotating Turret. Information is given about the powering of the two machine-gun turrets of a Navy plane. The turrets are mounted one above the other, each unit operating independently. It is explained that, because of the location of these two turrets with relation to each other and because of the large amount of equipment necessary for their operation, a great deal of engineering ingenuity was necessary to design a workable assembly that left space for the installation of all necessary equipment. After the hydraulic and oxygen systems had been designed, a space of only $4^1/_4$ in. was left in which to install the electrical equipment.

To effect a connection between the various circuits in the body of the plane and the moving turrets, a slip ring and brush assembly system (stator and rotor) was selected in preference to a flexible cable, which would permit only a limited number of turret revolutions. The manufacture of the stator and rotor is described. *Modern Plastics*, October, 1944, pages 125–127, 186, 188, 13 illus.

The Microstructure of High-Density Plywood. William M. Harlow. The microstructure of high-density plywood, which is commonly known as "compreg," is discussed. Softening technique to facilitate the sectioning of this hard material is described. Four conclusions reached are: (1) High-density plywood can be successfully sectioned by pretreatment in hot aqueous 10 per cent sodium hydroxide. (2) Penetration of the resin is variable as between different samples. (3) Usually the zone of greatest penetration is along the original surfaces of the veneer sheet. (4) In such cases, the greatest compression occurs near the center of the sheet.

A transverse section of a German propeller blade is illustrated. *Mechanical Engineering*, October, 1944, pages 656, 657, 3 illus.

Calculating Time-Temperature Schedules for Curing Resin Adhesives. Thomas D. Perry. The proper cure of resin adhesives is discussed. It is explained that there is a wide range of special constructions for which no standard time-temperature schedules have been developed and for which individual determinations need to be made.

It is important to predetermine, so far as practicable, an approximate bonding requirement in order to ascertain such facts as plant capacity and production costs on any new item on which shop experience is not available. For such cases a method is described which has been developed to calculate the required bonding cycles. Two basic graphs required for calculating a special schedule of required clamping cycles for any special resin-bonded construction are shown.

Also shown are a graph and a table for the rate of cure of a moderate-temperature phenolic resin adhesive.

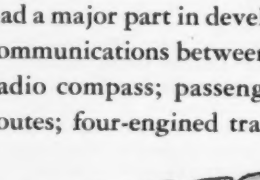
Sections of the article discuss the absolute rate of cure, the rate of heat penetration, the determination of formulas, and computation procedure. *Modern Plastics*, October, 1944, pages 153, 154, 3 illus.

PIONEER AIRLINE *is still going strong*

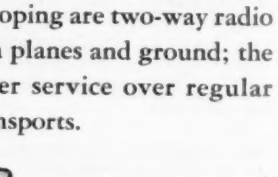
Early photo shows Western Air Lines' first pilots ("The Four Horsemen"), with Gen. Mgr. C. C. M... far right. Left to right, pilots Fred Kelly; Jimmie James; Al deGarmo, and Maury Graham; M... Behind it Western's first plane, the Douglas M-2.

SINCE APRIL, 1926, when flight operations began, pioneering has been a habit with Western Air Lines, which serves the Pacific Southwest and Rocky Mountain territories. Among features of safety and service which this one company has had a major part in developing are two-way radio communications between planes and ground; the radio compass; passenger service over regular routes; four-engined transports.

FIRSTS—



Pioneered two-way radio communication

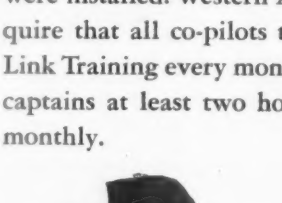


Carried first passenger on air mail route

Operated first 4-engined airliner

Developed long-distance weather forecasting

Western Air Lines installed the first Link Trainer in 1937, for the instruction of pilots in instrument flying. When the company established its military training division, three more Link Trainers were installed. Western Air Lines' regulations require that all co-pilots take at least four hours' Link Training every month...captains and reserve captains at least two hours' "refresher" courses monthly.



Among the four pilots with whom Western began was Jimmie James. Now Vice President in charge of Operations, Mr. James states: "No single device has contributed more to the safety standards maintained by the nation's airlines than the Link Trainer."

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Postwar Aviation

From R.A.F. To Civil Aviation. Part III. Squadron Leader G. A. B. Cooper. Part III in a series reviewing the career possibilities for R.A.F. personnel in postwar commercial aviation contains advice about becoming a flight engineer. The job at present requires no license as such. The article then goes on to describe the responsibilities of each air-crew member toward the crew as a team, toward the specific jobs of other members of the crew, and toward standards of public service. Information is given about the status and pay of air crews in civil life, with the general opinion offered that the financial remuneration in the case of technical members is practically equivalent to that of commissioned officers in the Service. Professional associations for pilots, navigators, and radio officers are named. While the series of articles is intended to deal primarily with flying jobs, in Part III some indication is made of ground-staff jobs that will be available. These are discussed under three general headings: engineering, operations, and commercial. Potentialities in airport management and associated civil aviation occupations are also investigated.

In considering the prospects of obtaining appointments, the writer predicts two pertinent periods of development: (1) immediately after the war, when an early demand will arise for the staffing of air lines and ground organizations, but when the available supply of suitable men will still be short; (2) some time after that, when a greater number of men will have been released from the services, but when the more desirable jobs will already have been taken. To offset these conditions, he suggests that those seriously considering air transport as a career should start to get their qualifications as soon as it is physically possible. He also proposes a plan whereby such men would be given a chance to register now with the Air Ministry and air-transport organizations so that they may be given fair consideration when the first period starts for transferring men from military to civil air services. *The Aeroplane*, September 1, 1944, pages 256, 257.

From R.A.F. to Civil Aviation. Part IV. Squadron Leader G. A. B. Cooper. In this concluding article of a series reviewing the career possibilities for R.A.F. personnel in postwar commercial aviation, a plea is made for a well-organized national system of registering, selecting, and converting R.A.F. personnel who wish to work in the air-transport field after the war. Prospective applicants for civil air-crew jobs are advised to seek information from the Guild of Air Pilots and Air Navigators of the British Empire and from the British Air Line Pilots' Association. Statistics on the background history and indicated development trends of British air-line companies and feeder lines illustrate the channels into which the energies of would-be transport aviators can be directed. *The Aeroplane*, September 8, 1944, pages 275, 276.

Where Next? Part II. Edward Warner. This is the conclusion of a two-part article by the Vice-Chairman of the *Civil Aeronautics Board* discussing future air-line traffic and how it will be handled. Attention first is given to local passenger and cargo service and the prospects for international air travel are then discussed. Charts are supplied showing the potential air-cargo traffic at various ton-mile rates and the potential trunk-line air-passenger traffic at various fares. *Air Transport*, October, 1944, pages 79, 80, 83, 86, 89, 3 illus.

Air Cargo in Post-War Distribution. A. E. Gaul. Pointing out that the transport plane is likely to make important changes in postwar cargo distribution, the writer examines its possibilities in the near future. The economy of air transport and the relation of air cargo to other forms of transport are discussed, and air-cargo rates are compared with rail freight rates. Consideration is given to reloading from surface to air carrier and back again. It is stated that too little thinking in the aircraft industry appears to have been devoted to reducing rehandling by unit loading. Handling equipment and other equipment, including fastening devices and high-lift units, are discussed. Other sections of the article discuss shipping schedules, feeder lines, the use of gliders, the location of airports, and foreign traffic. *Distribution and Warehousing (D and W)*, October, 1944, pages 40, 109, 110, 112–114, 3 illus.

'Customer Who Needs Plane Will Buy One.' E. J. Foley. Observations are made on private flying prospects and the possible parallels to automobile history. It is stated that two significant determinants of the future private airplane market are obviously cost (initial and recurring) and usefulness.

The writer believes that too much emphasis is placed on the importance of the initial cost of the airplane. He sees usefulness as the important factor in the private plane. The problem of accessibility is discussed, and it is noted that upkeep is materially affected by this problem. Transportation to and from the airfield must be included in recurring costs. It is stated that the distribution of parts and availability of qualified service are nation-wide problems of the private plane makers. *American Aviation*, November 1, 1944, page 72.

A Preface to Postwar Planning. Part IX. George E. Haddaway. The concluding article in a series dealing with various problems that require solution preparatory to the establishment of a sound postwar aviation program for the United States. In this final article, the points that have been made in the preceding installments are summarized, and the need for action on the part of the industry in prevailing upon political leadership to initiate such a program is reiterated. The résumé covers the discussion of issues pertaining to federal aviation policy, scheduled air transport, private flying, state and municipal responsibilities, airports, America's postwar air force, and a suggested air-policy committee. *Southern Flight*, October, 1944, pages 28, 29, 40, 70.

Better Buy Bonds. William Flynn. This is a compendium of opinions from light-plane manufacturers regarding the price range of postwar private aircraft and the type of plane that will be offered. The men quoted are: W. T. Piper, President of the Piper Aircraft Corporation; James C. Hart, President of the Taylorcraft Aviation Corporation; T. Bowring Woodbury, Vice-President of the Culver Aircraft Corporation; G. S. Hancock, Jr., Sales Manager of Commonwealth Aircraft, Inc.; William Wagner, Public Relations Director of the Ryan Aeronautical Company; Harry Agerter, Sales Manager of the Engineering & Research Corporation. Pertinent comments from two other members of the aviation industry are included: Oliver L. Parks of the Parks Air College and William B. Stout of the Stout Research Division of Consolidated Vultee Aircraft Corporation. While ideas as to the type of plane vary, opinions on the price factor are unanimous. All the manufacturers quoted agree that the postwar private airplane will cost more than the prewar light plane. *Air Facts*, November, 1944, pages 30–41.

From Air Force to Air Commerce. Eugene Wilson. The writer discusses an interpretation in terms of air power of the fundamentals first expressed in 1889 by Admiral Mahan in his study *Influence of Sea Power Upon History*. Applying this doctrine to the air, he sees the United States passing into the air age with power to build, operate, and protect a system of commerce, defense, and communications in the air which is parallel to the sea power that maintained the so-called "Pax Brittanica" for more than two centuries. Sections of the article discuss subsidies, quantity output, competition versus monopoly, and the maintaining of United States' air power. *Air Transport*, October, 1944, pages 20–23, 10 illus.

Private Flying

Planning for Private Flying. "Contaire." A commentary is given by a British writer on the future prospects for private flying. Emphasis is placed on the importance of efficient planning for private flying after the war. It is stated that the first consideration of those who may be engaged in the planning of private flying should be that of reducing expense. The writer would like to see flying clubs established at every place where airfield space and population—that is, potential membership—exist. He believes that these should be affiliated with a central body to administer the flying and technical side. It is stated that improved types of aircraft and engines, coupled with improved navigational facilities, should make possible a reduction in insurance

LOOK TO CANNON 'DP' CONNECTORS IN 1945

HERE ARE A FEW OF THE 'DP' CONNECTORS AVAILABLE *NOW*— AND MANY NEW DESIGNS ARE COMING

NEW applications of the exclusive Cannon Electric "DP" series of connectors have recently been extended from rack equipment in radio assembly to such uses as special centralized aircraft control on through to signal relay equipment.

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Cannon Type DP Connectors cover a variety of rack, panel and bail-type fittings, carrying from eight to 135 circuits with amperage range from 10, 15, 30 and 40 in many varied arrangements, including coaxial contacts.

All these and many other high quality electrical connectors are Cannon designed and manufactured.

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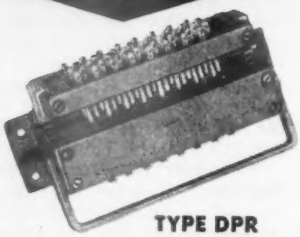

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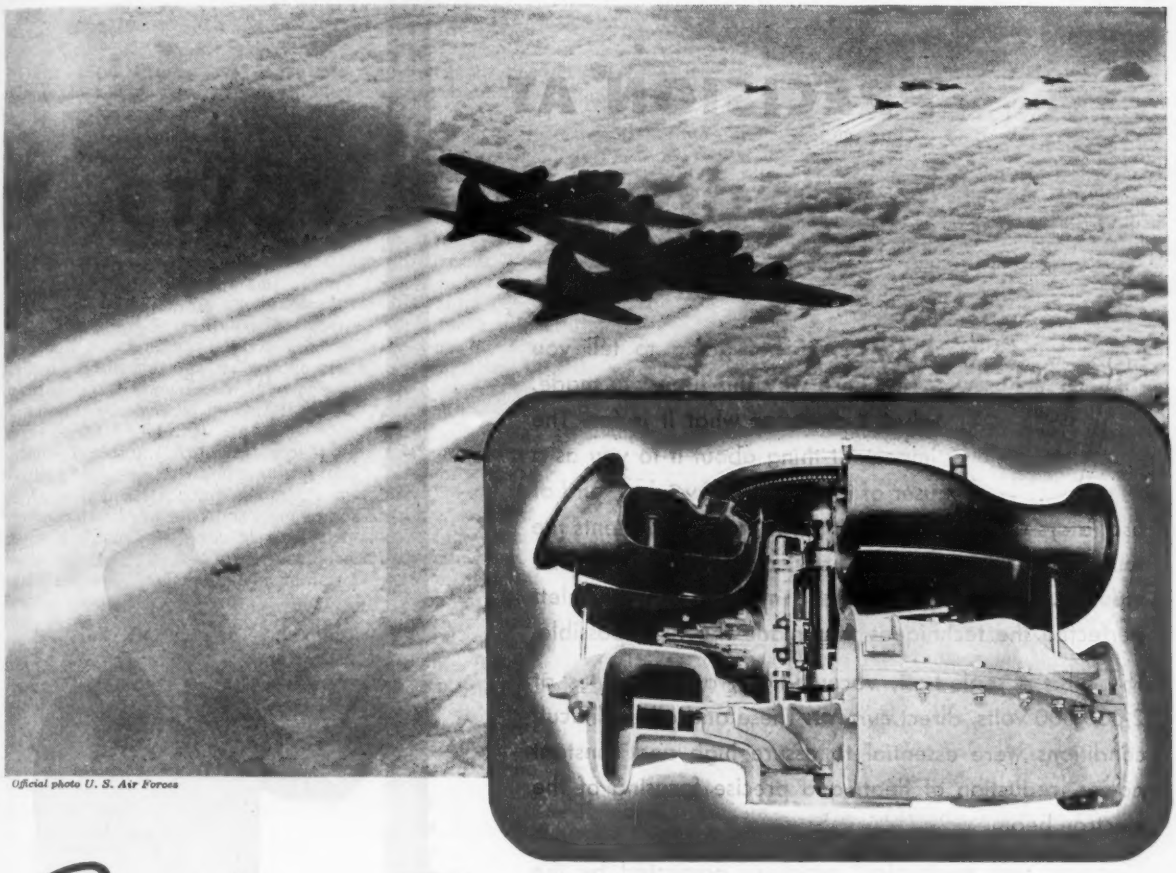
premiums. Private owners who are members of flying clubs should be enabled to have their aircraft housed and serviced on favorable terms. Three basic types of aircraft with which it is believed every flying club should be equipped are described. *Aeronautics*, October, 1944, pages 24–27.

More Airports for the Personal Flyer. Charles I. Stanton. Pleading the cause of adequate landing facilities for postwar private flyers, the *Deputy Administrator of the Civil Aeronautics Administration* reviews some proposals that have been made for the development of a civil airport system in the United States. He also expresses his own views regarding the type of landing area that should be established. Features of programs and appropriations recommended by the Civil Aeronautics Authority, the Randolph Bill introduced in the House of Representatives, and the Personal Aircraft Council of the Aeronautical Chamber of Commerce are included.

The writer predicts that 99 per cent of postwar air traffic will consist of relatively small private and commercial planes. He uses this estimate as the basis for the statement that, therefore, nonscheduled aviation is entitled to the major share of immediate airport development. Rather than flight strips located along highways, he favors, for personal fliers, small airports having a planned relationship to the communities, country clubs, summer resorts, places of concentrated employment, etc. He does not believe that two-way (one-strip) airports are desirable at all, except under unique circumstances. As for proposed airway "marker" systems, he offers a simplification in the suggestion that existing longitude and latitude divisions on the United States map be reduced to smaller sections and that the resulting coordinates be the basis of "air addresses" which would be prominently lettered on landmarks such as towns, mountains, rail and river junctions, etc. *Aviation*, October, 1944, pages 118, 119, 260–264, 1 illus.; "What's Ahead for Private Flying," by Lee N. Brutus, *Southern Flight*, October, 1944, pages 32, 33, 72, 76.

Well—I've Zipped! William D. Strohmeier. An article praising the light plane's utility. The writer tells of his own experiences in saving traveling time by using a light plane and reports that weather delays over a reasonable period of use are the exception rather than the rule. He makes the point that the light plane will prove its efficiency if employed for purposes to which it is suited. One of the primary purposes indicated is its use for making long trips involving many stops. Dissatisfaction in the minds of private owners is attributed to three basic reasons: (1) They expect too much. (2) They try to use their planes for some trips where other transportation means are admittedly best. (3) They do not acquaint themselves with a few simple methods, noted by the writer, for facilitating cross-country flying. *Air Facts*, November, 1944, pages 11–16.



Official photo U. S. Air Forces

Breathing Fire at 65 below Zero

At eight miles up, where the air is too thin to sustain combustion, it must be compressed and crammed down the airplane engine's windpipe. That's the job of the ingenious device shown above—the turbosupercharger.

One half is a rotary compressor—the other half a gas turbine, driven at some 30,000 r.p.m. by the flaming exhaust gas from the engine.

Simple? How about severe thermal stresses created by hot gas at 1500° expanding the metal from the inside and frigid air at 65 below zero contracting from the outside? What of tons of centrifugal force trying to pull the rotor apart—to say nothing of corrosion and the scouring action of the rushing gas?

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WE ARE not going to tell you here why this tube was made, what it does, or what it is for. The important thing about it to you as a user of industrial X-ray tubes, and of oscillators for induction heating, is that it represents the toughest assignment ever handed the electronic tube industry, and that of all tube makers only Machlett perfected the techniques that made the tube possible.

The tube is sealed-off, vacuum-tight, and operates at 2,000,000 volts, direct current. These and other difficult conditions were essential to assure high and constant power, reduction of heat, and precise focusing of the electron beam.

Electrical and mechanical problems presented by the tube were so severe that some scientists doubted they could be solved, but Machlett, drawing upon its long experience, met every requirement in a little over two years.

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The perfection of this 2,000,000-volt direct-current tube is the best proof we can offer of the value of the Machlett skills that go into the design and manufacture of every tube bearing our name . . . Machlett Laboratories, Inc., Springdale, Connecticut.

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TODAY THEIR LARGEST MAKER

Production

Over 1500 Production Machines. Joseph Geschelin. An account of what has been accomplished by the Cadillac Division of General Motors since it began its program of producing parts for Allison engines about 5 years ago. It is noted that, starting in 1939 with the manufacture of about five parts, the scope of aircraft-parts production has been extended to a large group of major parts and complete assemblies. Some of the many production machines with which the plant is equipped are listed. Precision machining methods are described. Illustrations of production operations are shown. *Automotive and Aviation Industries*, October 1, 1944, pages 24–30, 54, 14 illus.

Spot-Welding. Application of spot-welding techniques to the manufacture of Avro Lancaster components are investigated. Information is given about the equipment used, the type of electrode tips favored for these machines, and methods of cleaning the material before welding. Features of production, inspection, and testing procedures are noted. It is reported that 15,000 welds are already being made on the Lancaster and that application of the process is being continually extended. Employment of spot welding in place of riveting is claimed to result in the following advantages: increased production speed, saving in labor, reduced skin friction of parts, increased rigidity in panels, and the elimination of holes and, consequently, potential leaks when used on tanks. *Aircraft Production*, October, 1944, pages 474–478, 10 illus.

High Speed Milling. Kenneth Macker. This article outlines the principles involved in high-speed milling and describes the application of the new practice to the high-speed milling of alloy steels and light metals at the plants of North American Aviation, Inc. The writer defines negative-rake cutting and describes how the company developed a technique for building its own milling cutters. *Metals and Alloys*, October, 1944, pages 949–953, 10 illus.

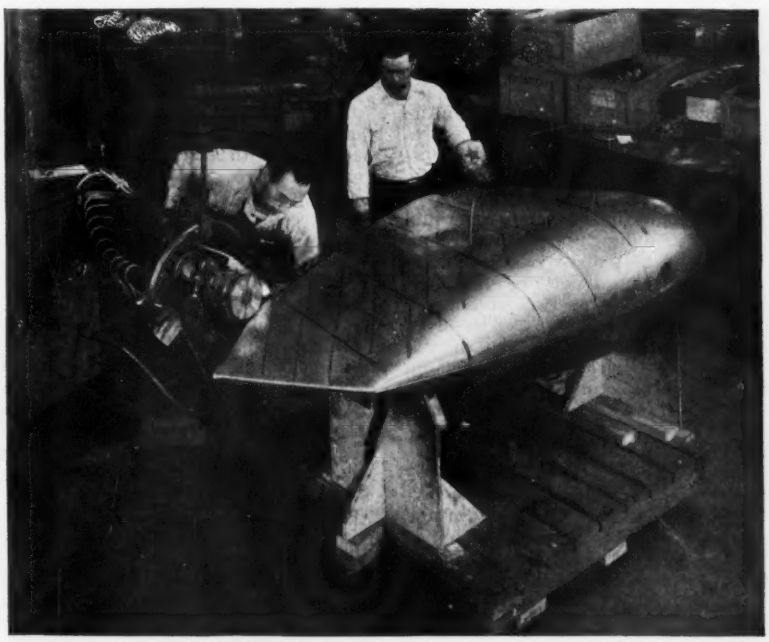
Quality Control and Industrial Development. R. H. S. Phillips. This is a nonmathematical essay on experimental statistical analysis. The writer discusses the control of use-quality and describes the application of quality control to a theoretical product. Consideration is given to variables that must be watched for their effect on assembly quality, check-testing, the collecting of data and keeping of records, and the statistical knowledge required to carry out such an analysis as the one outlined. *Aircraft Engineering*, September, 1944, pages 265–267.

Continuous Hardening of Engine Parts. Willard Roth. This article discusses the hardening and quenching of engine parts in continuous and automatic-type furnaces using protective atmospheres. Some of the furnace types that have been found best suited to the continuous hardening of engine parts are described. Sections of the article discuss continuous hardening furnaces for small hardware for parts that must be quenched with a fixed orientation, and for fixture quenching. The rotary-hearth furnace for manual handling and fixture quenching is also described. *Steel Processing*, October 1944, pages 663–666, 4 illus.

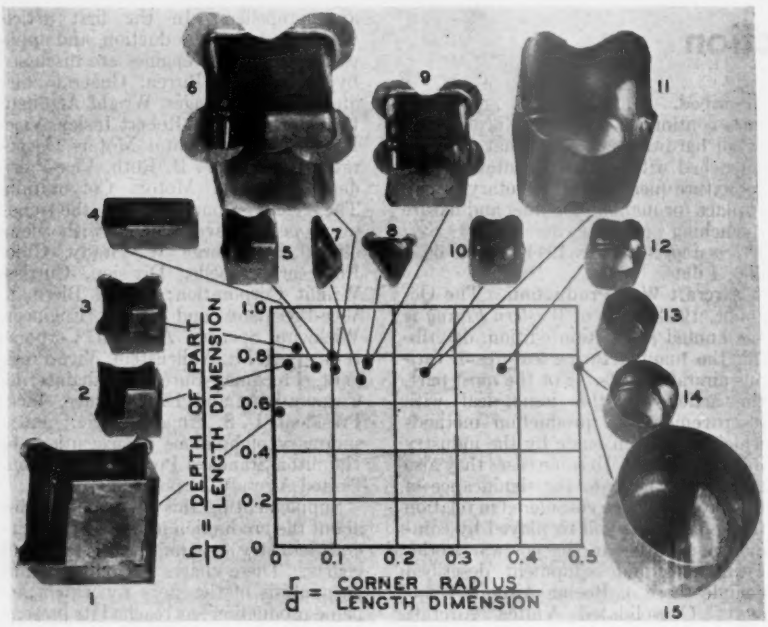
Aircraft War Production. The October, 1944, issue of *Western Flying* is the annual production edition, describing the manufacturing features of various aircraft plants. For the most part, the articles in this issue deal with improvements in production methods which have been made by the industry in the last year. In some cases they also attempt to indicate the significance of this progress when considered in relation to the part that will be played by commercial aviation in the postwar world. Techniques and equipment described include those of Boeing Aircraft Company, Consolidated Vultee Aircraft Corporation, Bell Aircraft Corporation, Ryan Aeronautical Company, Lockheed Aircraft Corporation, Taylorcraft Aviation Corporation, Curtiss-Wright Corporation, and Goodyear Aircraft Corporation. Other companies whose operations are reviewed are Douglas Aircraft Company, Inc.; The Glenn L. Martin Company; North American Aviation, Inc.; Luscomb Airplane Corporation; Laister-Kauffmann Aircraft Corporation; Fairchild Engine & Airplane Corporation; and Chance Vought Aircraft Division, United Aircraft Corporation.

Two articles in the magazine are devoted, respectively, to aircraft engines and propellers. In the first article trends in design, production, and application of aircraft engines are discussed by William B. Birren, General Sales and Service Manager, Wright Aeronautical Corporation; Robert Insley, Vice-President, Continental Motors Corporation; and C. F. B. Roth, Vice-President, Aircooled Motors Corporation. The second is concerned with the trends in propeller development, with views offered by George W. Brady, Chief Engineer, Propeller Division, Curtiss-Wright Corporation; David Bierman, Vice-President and Chief Engineer, Wickwire Spencer Aviation Corporation; Bert M. Wallenstein, Vice-President, Freedman-Burnham Engineering Corporation; and E. L. Bruce, Vice-President, U. S. Propellers, Inc.; and a summary of opinions by executives of Hamilton Standard Propellers Division, United Aircraft Corporation.

Supplementing this group of articles about the production progress of the aircraft industry are a number of statistical charts. These charts not only contain an analysis of the steps by which airplane production has reached its present stage but also serve as a basis for projecting certain factors into the future. *Western Flying*, October, 1944, "The B-29 Production Program," pages 70, 71, 152, 154, 6 illus.; "Manufacturing Breakdown," by Thomas A. Dickinson, pages 72, 73, 156, 158, 170, 8 illus.; "Building the Kingcobra," by Lester L. Benson, pages 74, 75, 160, 162, 6 illus.; "Production Riveting by Machine," by J. E. Cooper, pages 76, 77, 164, 9 illus.; "Lockheed Moves the Constellation Line" pages 78, 80, 82, 6 illus.; "Air Tools at Aircraft," pages 84, 86, 6 illus.; "Curtiss Production Techniques," pages 96, 98, 162, 8 illus.; "Flexible Conveyor Line," by Russell



A portable seam welder is used to attach the top pan to a welded-steel 150-gal. jettison tank after assembly of half shells by seam welding.



Correlation of size, shape, and depth of deep-drawn parts.

De Young, pages 100, 102, 166, 5 illus.; "Prelude to D-Day," by F. W. Herman, pages 108, 109, 176, 9 illus.; "Wing Production Shortcuts," by M. W. Lacko and R. F. Lauer, pages 110, 111, 168, 170, 6 illus.; "Conversion: B-25–P-51," pages 112, 113, 178, 5 illus.; "Luscombe Builds Bomb Doors for Avenger," pages 114, 178, 4 illus.; "Glider Production Techniques," by M. Nanson Whitehead, pages 118, 180, 3 illus.; "Engines—A Symposium," pages 120, 122, 124, 126, 2 illus.; "Propellers—A Symposium," pages 128, 130, 132, 134, 136, 138, 5 illus.; "Fairchild Builds a 'Pilot Plant' for Cargo Plane," page 140, 1 illus.; "Vought Conveyor Speeds Production," page 142, 1 illus.

Frame Design and Mounting of Aircraft Windows. W. H. Arata, Jr., and O. E. Brown. This article discusses the design of the aircraft window frame and the method of mounting the plastic window in the frame. The subject of frame design is dealt with first. It is noted that many of the limiting factors in frame design are introduced by the physical properties of the materials used for the frames. The physical properties of metals used in window frames are listed to provide a rough means of comparison, but it is explained that actual selection depends on overall considerations. Information is given about the forming limits of the frame materials and the sealing of the windows in the frames. Window materials are discussed and tables of the properties of recommended materials are included. *Industrial Aviation*, October, 1944, pages 50–52, 54, 101, 8 illus.

Refrigeration of Coolants for Machine Tools. B. S. Williams. The writer describes how the refrigeration of the coolant or cutting oil for machine tools has been successfully applied by the Airtemp Division of Chrysler Corporation to reduce tool wear, improve the finish of parts, and increase production. *Heating and Ventilating*, October, 1944, pages 63–66, 3 illus.

Blanking and Forming Aircraft Parts at Boeing's Wichita Plant. C. W. Hinman. Types of hydraulic presses used at Boeing Airplane Company's Wichita plant are described, and information is supplied regarding the forming and drawing technique that is employed in the manufacture of many parts for the Flying Fortress and other planes. A 2,500-ton self-contained rubber pad-forming press used for shallow forming and flanging operations is described. A 2,500-ton rubber pad-forming press is also used for blanking. Details are given about a deep-drawing press equipped with a hydraulic blankholder and die cushion. The writer also tells how a single baler takes care of all the scrap coming from the plant. *Steel Processing*, October, 1944, pages 660, 661, 678–680, 9 illus.

Effect of Shape on the Formability of Deep-Drawn Sheet-Metal Parts. W. A. Box and William Schroeder. This paper presents experimentally determined results of the effect of size and shape on the limits for single-operation deep-drawn parts. It is pointed out that the important elements that must be considered in determining the drawing limits are the overall dimensions of the base of the part; the size of corner radii; the shape of the part, whether round, square, rectangular, or irregular; and the thickness of the material. Punch nose radii and draw radii must also be considered in order to obtain optimum results. A description is given of draw-forming methods. The experimental procedure is described in detail and results and correlations are set forth. The article ends with a summary of the findings. *Mechanical Engineering*, October, 1944, pages 643–648, 662, 16 illus.

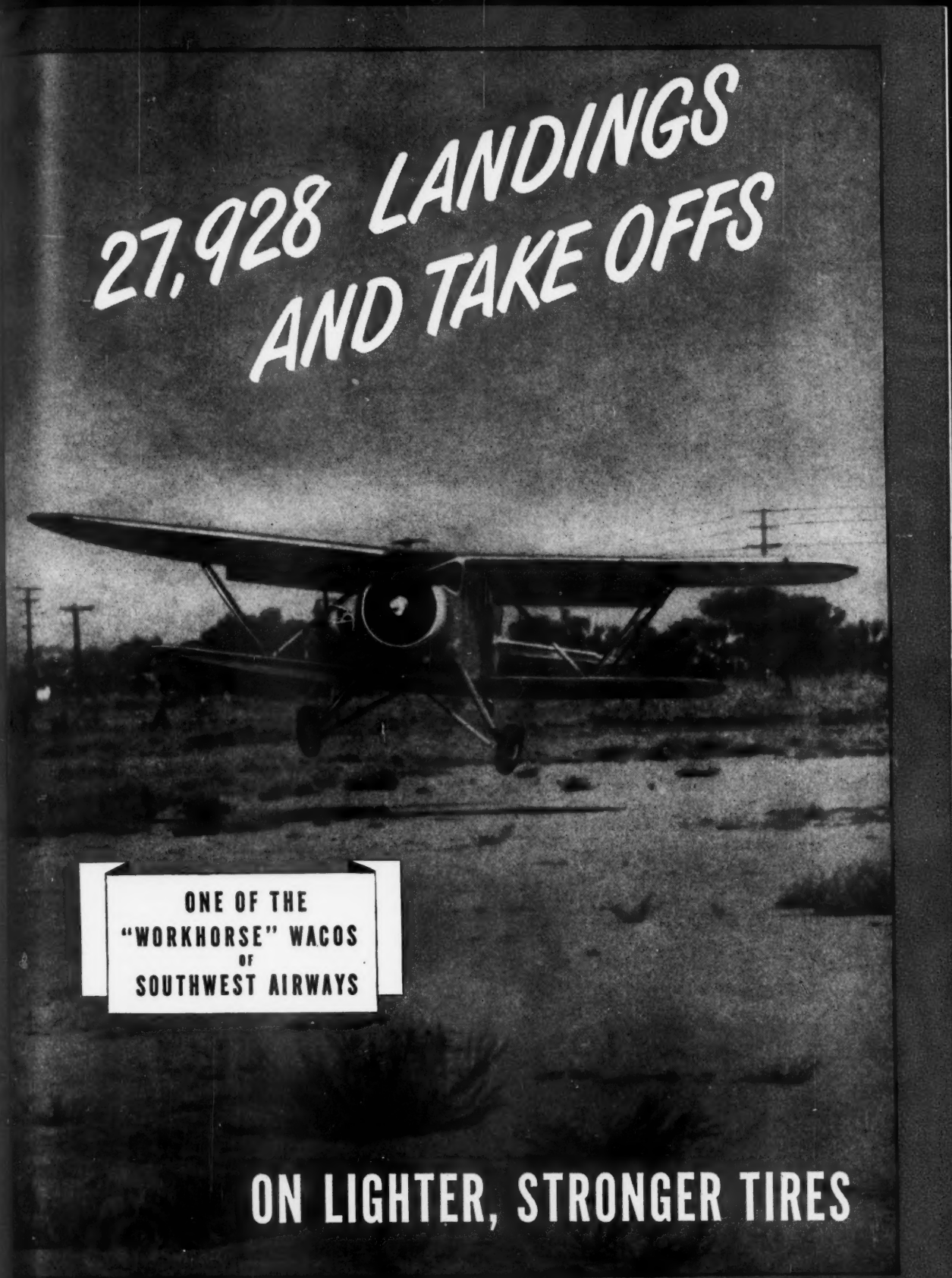
Economical Tooling of Airplane Parts. David A. Cook. This article contains data on plastic tooling based on the writer's personal experience over a period of about 3 years in the design, fabrication, and operation of various types of plastic tools, and his observation of the work of other fabricators. After a brief review of the usual tooling processes, instances are cited of the durability of plastic tools. Methods of construction and costs are discussed and compared with those of similar metal parts. Illustrations include a blueprint of a typical assembly draw rail to die block and photographs of typical aircraft parts and the blocks from which they were formed, typical plastic forming dies, and some parts exactly as they were struck without any hand working having been done on them. A table presents a comparison of various types of tooling. *Modern Plastics*, October, 1944, pages 140, 141, 206, 5 illus.

Recent Advances in Making Aluminum-Alloy Forgings. L. W. Davis. Reference is made to the fact that the production of aluminum forgings is a relatively new industry and that much of the forging technique has been developed by American engineers. The types and designs of forging dies employed in the manufacture of aluminum-alloy forgings are described. Information is supplied about the selection of the alloy, the preparation of the stock, and the forging and heat-treating operations required to produce aluminum-alloy forgings of specified characteristics. Tables give data concerning thickness, shrinkage, and mismatch tolerances; forging temperatures; heat-treatment and aging; and mechanical properties. *Machinery*, October, 1944, pages 145–150, 5 illus.

Propellers

Five-Bladed Airscrew. An announcement that the Spitfire XIV is being fitted with a Rotol five-bladed propeller is supplemented by an explanation of the advantages offered by this type of propeller. In addition to meeting climb and cruising requirements while maintaining top-speed performance, the five-bladed propeller is said to compensate for "under blading"

A phantom view of an Aeroprop propeller blade. (1) Brazed surface; (2) leading edge; (3) camber sheet; (4) thrust member; (5) trailing edge; (6) cuff ring; (7) buttress thread.



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"Fast taxiing...hard breaking" Capt. Ted R. Mitchell, Operations Manager, Southwest Airways, writes . . . "Operating procedures set up called for fast taxiing, which, in turn, necessitated frequent, hard braking. The intense heat thus built up placed entirely too severe a strain on the original equipment. Tires and tubes gave out in as little as 30 hours flight time. The effective role played by your products enabled us to solve this serious problem."

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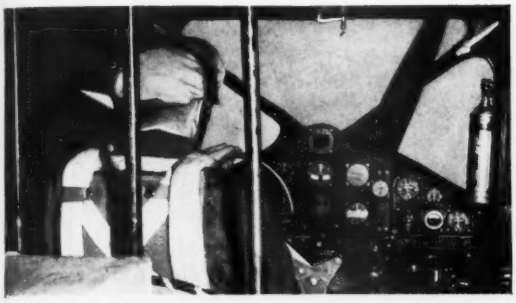
HOW SOUTHWEST CONVERTED ITS PLANES —TO CARRY HEAVIER LOADS

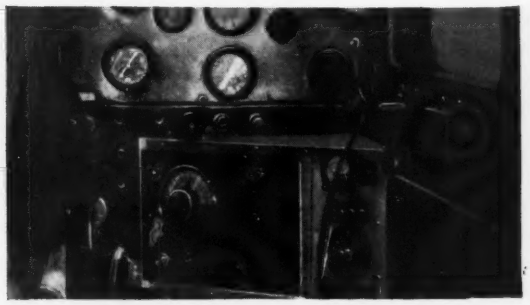
The sturdy Wacos required changes in interior design and construction before they could be transformed from private planes to commercial cargo carriers. Original modification was designed by Southwest Airways' associate company, Southwest Aircraft Corporation. Modification was completed at Southwest Airways own maintenance shops. Here are some of the major changes.



CARGO BARS: Steel cargo bars were installed behind the pilot's seat to guard against shifting cargo.

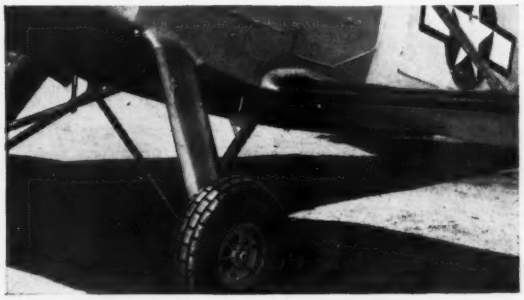
CARGO DOOR: Cargo and pilot doors were cut into the left side of the plane to permit loading of bulky cargo.

CARGO COMPARTMENT: The cargo compartment was increased to maximum size to carry 72 cubic feet of freight.



RADIO EQUIPMENT: Co-pilot's seat was removed and a two-way radio unit installed for constant contact.

WHEELS: Heavy freight loads were too great for the original wheels. Heavier, more rugged wheels were installed.



TIRES: The same size U. S. Royals that equipped the pre-war Wacos made every one of the 27,928 landings!

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Since the first day of Southwest's feeder line operations, U. S. Royal Airplane tires have equipped their "Workhorse" Wacos . . . and inside every tire is the U. S. Royal Fabric Base tube . . . the tube that increased tire performance, on these planes, 1100%.

Hard braking, fast taxiing, sharp turning built up terrific heat in brakes and wheels. Southwest Airways maintenance engineers called in U. S. tire experts to help find the answer. Taking a leaf from their experience on bus lines where high brake-drum heats are often encountered, they suggested U. S. Royal Fabric Base tubes.

Equipped with these special tubes, introduced to the airplane industry by "U.S.", tire life increased almost overnight. Today, instead of failing after 30 hours of service, Southwest's U.S. Royal Airplane tubes are giving 3300 hours and more . . . are contributing to the outstanding record built up by Southwest in more than a million miles of feeder flying.

This is another example of the practical engineering service "U.S." offers to the aircraft industry through its Field Engineers . . . serving through science to speed the victory.

Lighter, stronger U.S. Royal Airplane tires with bodies of rayon or nylon are serving today on fighters, bombers and transports in every corner of the world, carrying heavier loads safely, surely, dependably.

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2¾% Nickel Steel locomotive rods, one bent cold to show ductility.

QUENCHED AND TEMPERED NICKEL STEEL FORGINGS COMBINE

EXCEPTIONAL DUCTILITY WITH HIGH TENSILE STRENGTH

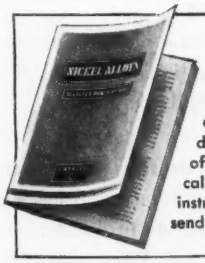
Composition and Typical Properties of Normalized Quenched and Tempered 2¾% Nickel Steel Rods

Description or Size	Melt Yield Pt. No. #s per Sq. In.	Tensile Strength #s per Sq. In.	Elong. % in 2 In.	Reduction in Area %	ANALYSIS					
					Car.	Mang.	Phos.	Sul.	Sil.	Ni
Main Rod....	92900	110000	25.0	64.4	.31	.78	.027	.026	.25	2.75
Main Rod....	86500	104500	25.5	65.6	.32	.86	.034	.032	.29	2.69
Main Rod....	86360	104400	26.0	64.8	.32	.86	.034	.032	.29	2.69
Main Rod....	87850	102350	26.0	66.2	.31	.89	.037	.025	.32	2.69
Front Rod....	86000	102250	25.0	67.3	.29	.82	.035	.027	.24	2.71
Front Rod....	83900	104250	25.0	66.1	.29	.82	.035	.027	.24	2.71
Front Rod....	86850	104250	27.0	66.1	.32	.86	.035	.025	.30	2.65
Front Rod....	89500	107050	25.5	65.6	.32	.86	.035	.025	.30	2.65
Back Rod....	89500	107650	25.0	62.7	.30	.79	.030	.025	.22	2.71
Back Rod....	87500	106450	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	87000	105600	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	88150	104850	26.0	66.8	.29	.82	.035	.027	.24	2.71

Specimens Taken from Mid-Section of Prolongations of the Forgings

The above table compiled by the American Locomotive Company shows the chemical compositions and mechanical properties of some normalized, quenched and tempered nickel steel front, main and back rods recently produced as replacement rods for locomotives being speeded up and rebalanced. These values are typical of replacement rod forgings recently tested by that company.

Quenched and tempered nickel steel forgings provide high tensile strength and ductility, combined with unusual toughness and high fatigue strength—qualities which tend to obviate breakage and assure long, trouble-free service when employed in heavy duty machinery and equipment.



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TAKE the machines and materials of our temperate civilization into 120° of desert heat and you get some new problems...

Actually, 100 octane Aviation Gasoline—volatile—stewing in a desert fuel dump of steel drums, tends to separate into its constituent parts . . . gets "gummy."

This was one of the hazards of a war in which aviation gasoline must be kept "on tap" in the hottest spots of all geography.

* * *

Scientists at the "University of Petroleum," Shell's research laboratories, found the answer to this new wartime problem . . . a new, revolutionary "inhibitor." A few drops in a barrel of fuel, and its molecules stay put. Gum doesn't form . . . Storage of 7 years, at 120°, is possible. Although it is not yet in production, the Army Air Forces have accepted Shell's new inhibitor as a research achievement of prime importance to desert operations. Thus—one more outstanding contribution to America's war effort from Shell.

Shell Research made possible the first commercial production of 100 octane aviation fuel and supplied it to American Military Aviation—giving our planes new speed, flying range, and tactical advantage. Later Shell discoveries vastly increased both the power and production of aviation gasoline.

Today, more Shell 100 octane aviation fuel is supplied to aircraft engine manufacturers, for critical test and run-in purposes, than any other brand.

Farsighted airport operators will find Shell's wartime popularity a profitable peacetime asset.

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FINER FUELS FOR THE AGE OF FLIGHT

where the engine has a single-shafted reduction gear. *Aircraft Production*, October, 1944, page 480, 1 illus.

Expediting Propeller Production. John A. Roush. Special machinery and techniques developed to aid the manufacturer of Aeroproducts propellers are described. The subject is discussed in sections dealing with production advancements, brazing, balancing, dual rotation, and feathering. *Industrial Aviation*, October, 1944, pages 38, 41, 43, 102, 6 illus.

Radio

Rome Radio. George Herrick. An account is given of how aircraft radio equipment is repaired and overhauled at the Army Air Field, Rome, New York. The maintenance system provides individual attention for each unit overhauled and has the flexibility required to handle any kind of a radio job. *Air Transport*, October, 1944, pages 48, 50, 55, 56, 8 illus.

Rescue by Radio. Oliver Read and Ernest Barcella. An account of how the Radio Intelligence Division of the Federal Communications Commission locates lost or distressed aircraft equipped with two-way radio by means of its long-range direction-finding system. In addition to outlining the operating procedures of the system and indicating its value, the article contains details about the Adcock direction finder, which comprises the main piece of equipment for this work. It also includes information relative to the qualifications of R.I.D. operators. The locating system is credited with aiding the United States in the war against Japan, having guided safely homeward more than 500 bombers and other warplanes, saved scores of shipwrecked merchant seamen, and added another measure of safety to postwar flying. *Flying*, November, 1944, pages 26–28, 142, 144, 5 illus.

Maintenance of Radio Set SCR-274-N. Reference is made to one of the important duties of Air Service Command mechanics—that of keeping radio communication equipment in proper condition. Detailed information is given about the installation and maintenance of the SCR-274-N, a medium power communications set of multiunit, multichannel construction, designed to provide airplanes with short range plane-to-plane and plane-to-ground communication. *Aviation Maintenance*, October, 1944, pages 89, 170, 2 illus.

Reaction Propulsion

The Flying Bomb. Further particulars are given about the German flying bomb. The information was obtained through a visit to a research station of the Ministry of Aircraft Production where some of these machines were examined. It is stated that the flying bomb is a crude small aircraft designed for the greatest possible ease of production. What the writer calls the hull is constructed mainly from thin steel plate. Component parts are made in the simplest form, even at the expense of weight. The hull is designed so it can be broken down into easily transportable parts. A line drawing shows important features of design, including the air bottle that supplies power for the control system and fuel feed and the warhead that weighs a little over 1 ton. Further details are supplied on the propelling unit, wings, and spar. It is stated that the jet thrust has been calculated at about 600 lbs., which is sufficient to propel the bomb at about 360 m.p.h. The propelling unit is equal in performance to an aircraft engine of about 600 hp. The control arrangements of the aircraft are described. Specifications and dimensions are tabulated. *The Engineer*, October 6, 1944, pages 261, 262, 2 illus.

The Development of German Rocket Propulsion. H. J. A. W. In a brief review of the development of rocket propulsion in Germany, the writer traces the progress made in replacing expensive shells and guns by the relatively cheaper rockets and catapulting devices. Some of the early experiments leading to the present status of rocket propulsion are reviewed, together with comments regarding their effectiveness. *The Aeroplane Spotter*, September 21, 1944, page 220, 2 illus.

The First Robot Bomber. Gaither Littrell. The principles, construction, and operation of an American robot plane developed and flown in 1916 are described. Designed and manufactured by Robert Modisette, the "Hot Shot" is reported to have had self-operated flight controls, bomb releases, and scuttling devices. It was built of scrap spruce, rejected airplane cloth, and dope at a total cost of $452; had a wingspread of 46 ft.; and measured 19 ft. 8 in. from nose to tail. Unloaded, this robot bomber weighed 1,790 lbs. and carried three bombs weighing 65 lbs. each. It was powered with two Ford automobile engines and had a maximum speed of 72 m.p.h. at a ceiling of 1,500 ft. Its cruising range was 160 miles. Means were provided so that the craft was automatically disintegrated in mid-air after releasing its bombs. *Flying*, November, 1944, pages 44, 45, 4 illus.

Flying the Airacomet. Major Charles M. Fischer. The Chief Test Pilot of the Air Technical Service Command, San Bernadino section, gives his impressions of the P-59A after flight-testing the Bell-manufactured jet-propelled fighter plane. He reports on the simplicity of design and operation, the great speed, and the absence of noise, vibration, and static. He also indicates the advantages offered by jet-propelled planes in their elimination of propellers and the reduction of certain weight factors. *Flying*, November, 1944, pages 29, 146, 148.

Reconversion

Demobilizing Our Aircraft Industry. Harry Woodhead. Pointing out that surplus human beings cannot be stored like excess machinery, the President of Consolidated Vultee Aircraft Corporation discusses the problem of employment after the war. Figures are given on the number of employees working for basic aircraft manufacturers and subcontractors. It is stated that the national economy must be prepared to stand the shock of transitional employment for the greater part of 18,000,000 people engaged directly and indirectly in war production plus 11,000,000 members of the armed forces and nearly 2,000,000 others in war-related Government services. It is believed that avoidance of violent economic adjustment for a majority of aircraft workers will greatly benefit the nation. Various phases of the demobilization problem are discussed. *The Draftsman*, October, 1944, page 10.

Rotating Wing Aircraft

Landgraf Helicopter has Unique Design Features. William R. Nelson. Features are reviewed of the helicopter designed and built by the Landgraf Helicopter Company. Now under test, this helicopter has twin three-blade contrarotating rotors, situated side by side, but no tail rotor. These rotors are 16 ft. in diameter with 11 ft. between axes. They are of all-wood construction and have nonarticulating blades

Three-quarter front view of the new single-place Landgraf helicopter, with right rotor attached. Twin rotors are of 16-ft. diameter, with 11 ft. between axes. Contrarotating twin rotors are of all-wood construction with blades being made as separate units to fit over hollow, tapered spars.

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Reporter?

Most news stories break fast. Reporters and photographers have to get there—quick! This has always been a tough problem to most papers, but a problem that will some day be easy.

The answer lies in the post-war planes now on the drafting boards—and in the nation-wide system of landing fields and strips now in the planning stage.

For your own plane, specify a Franklin engine—light, smooth, dependable, economical—the outgrowth of 44 years of building fine air-cooled engines.

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made as separate units to fit over hollow, tapered spars. Besides the rotors, the design is characterized by meshing (rather than separate) rotor discs, attitude control by cycle operation of ailerons mounted near the tip of each rotor blade, attainment of fore and aft stability by locating center of gravity considerably forward of the rotor axes, and elimination of heavy and complicated gearing and shafting through use of tension-rod drive. Power is delivered to both rotors by a cable system from a single gear box and the control system is marked by the elimination of foot pedals. *Aviation*, October, 1944, pages 186–188, 288, 300, 303, 7 illus.

An Approach to the Practical Helicopter. E. Burke Wilford. A study of some of the principles involved in making the helicopter more efficient, more rugged, and more adapted to common use. The discussion centers about suggested improvements in the design and functioning of the rotor. These include suggestions pertinent to improvements in tip speed, blade design, and airfoils for the greater efficiency of the rotor in direct lift and in descent with power; proper feathering of the blade, varying the amount of lateral feathering with the forward speed; restriction of the flapping action of the blade; and stressing of the rotor hub mounting and landing gear for helping the rotor to maintain dynamic balance in some conditions of forward flight. Certain structural changes are deemed by the writer to be necessary in order to make the rotor hub and blades rugged. These are listed as follows: (1) Blades can be of stressed-skin, all-metal, plastic, or wood construction. They should be extremely stiff in the plane of rotation and have the right degree of flexibility along the span. Material should be fatigue-resistant. (2) The blade should not require too accurate an adjustment of incidence and weight for rotor balance. It should be possible to heat it from the engine cooling or exhaust to prevent ice formation. (3) The rotor hub should carry the large centrifugal loads across from one blade to another without going through so many heavily loaded bearings. Hafner tie-rod construction is an interesting solution. (4) The control system should be simplified and be made self-centering so that the pilot has the feel of working against any differential of lift, as is common in the airplane. Putting the center of pressure of the blade slightly back of the feathering axis is one way to do this. (5) The use of tapered blades helps solve the structural problem, for greater thickness and chord at root "pays big dividends" structurally in a feathered blade.

In conclusion it is stated that, with improved rotor systems, better airfoils, and simplification of structure, rotors 80 ft. in diameter can be built which will operate efficiently. It is this size of rotor which is indicated by the writer as necessary to produce a rotating wing aircraft that will operate at the minimum economical requirement for successful aerial bus service. Such minimum is set at 40 cents per ton-mile. *Aero Digest*, October 15, 1944, pages 96, 98, 100, 4 illus.

Superchargers

Developments in Cabin Supercharging. Hendry Lars Bart. A report is made of a joint investigation of problems involved in supercharging aircraft cabins conducted by American Airlines and General Electric Company. It is stated that the results presented are of a preliminary nature. The airplane on which the tests were conducted was a twin-engined Douglas XB-23. Modifications in the structure were made for the installation of the equipment necessary to carry forward the program. It is explained that the cabin cell was constructed on the principle of a football. The cabin walls were treated as a bladder, installed to prevent leakage in order to maintain pressure. Between the strengthened ribs and additional longitudinal stiffeners, plywood was inserted to give a restraining surface, free of sharp protruding edges, for the rubberized lining. The results obtained from seven test flights are described and the conclusions reached are listed. *Industrial Aviation*, October, 1944, pages 63, 63, 66, 103, 104, 5 illus.

Testing

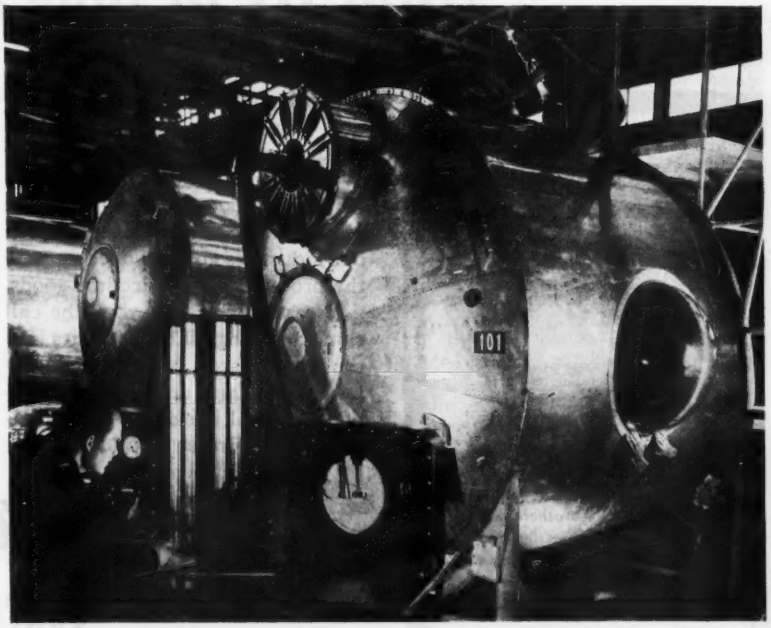
Testing Methods for Metal-Bonded Rubber. S. Buchan. This article describes the way a British rubber company prepares for the production of suitable rubber qualities for a few special applications and how some vulcanized rubber-metal bonded units are tested to prove their fitness for service. Information is given about the mechanical testing of an airplane-engine mounting that, in service, has to function in compression and shear and, occasionally, in tension. *Engineering*, October 13, 1944, pages 281–286, 8 illus.

A Simple Hydro-Press Formability Test for Sheet Metal. George C. Barber. A description is given of a test that is intended to provide designers with information about the extent to which metal sheets may be bent, stretched, or compressed under the rubber pad of the hydraulic press. The test is run on the Guerin-process hydropress at a unit pressure of about 1,200 lbs. per sq.in. The form block is of "dural", and is so designed that the test specimen is subjected in one operation of the press to all of the general types of forming likely to be encountered. Information is given about the relative formability of aluminum alloys. *Automotive and Aviation Industries*, October 15, 1944, pages 26–29, 86, 9 illus.

Tools and Equipment

Extending Cutting Tool Life by Refrigeration and Nitriding. C. S. Lucas and H. M. Hartley. This article deals with the production and application of refrigeration treatment and nitriding to purchased multipoint high-speed cutting tools. The writer discusses the use of sub-zero refrigeration as a means of reclaiming multiple-point high-speed tools that are too soft in the "as-received" condition. The use of salt-bath nitriding to obtain additional production yield on taps, chasers, and milling cutters also is discussed. *The Iron Age*, October 12, 1944, pages 74–77, 168, 9 illus.

Aerotool Metrology. Part I. H. Grafton. Taken from a paper read before the Institution of Production Engineers, this is the beginning of a two-



Pressure testing the gunner's compartment or rear cabin section of a Boeing B-29 bomber at a plant of the Boeing Aircraft Company.

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PRODUCTION FOR VICTORY — PRODUCTS FOR PEACE

part article on the science and means of measuring tools required for the manufacture of large aircraft components. In this section it is shown how the science of measurement can be applied to the building of more satisfactory tools with semiskilled labor. Describing the construction of typical fixtures used in the fabrication of large aircraft assemblies, the writer explains the need for, and the problems involved in, obtaining consistently accurate results through their employment. He then surveys various contact and optical measuring gauges, interpreting the functions and features of each. The equipment is discussed and includes the following: jig reference for checking the accuracy of an elevator assembly fixture; gauge for checking the interchangeability of components produced on the elevator assembly fixture; starboard-flap interchangeability gauge; precision bubbles, clinometers, slip-gauges, height-gauges, set squares, and internal stick-micrometers; tail-plane jig reference gauge; cylinder type of datum for taking diagonal measurements during tool assembly; mounting platform with machined edges for measuring locations; aileron interchangeability gauge; and theodolite. *Aircraft Production*, October, 1944, pages 493–498, 15 illus.

Training

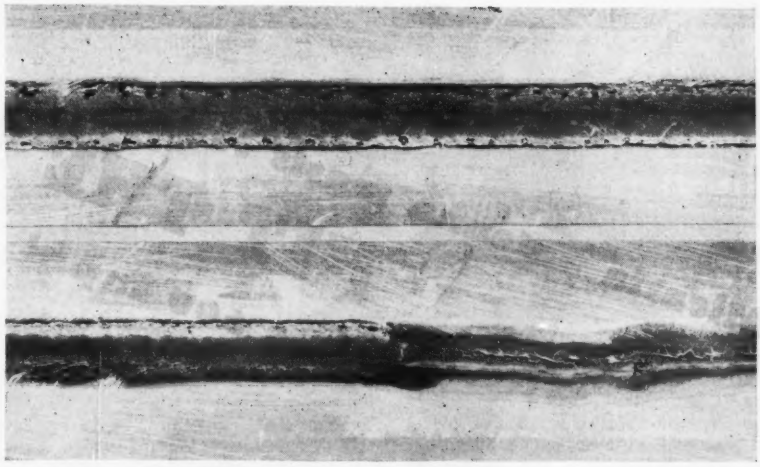
How to Train Airline Airport Personnel. E. L. Williams. The fundamentals of a specialized type of training for operating and servicing personnel of the airport industry are discussed. After explaining what is meant by operating and servicing jobs, the writer defines the importance of training conferences in preparing a practical education program. He advises the setting up of an advisory committee for analyzing various jobs and recommending the type of training needed for those jobs. The value of preliminary training, of "on the job" training, and of up-grading training is indicated. *Airports*, September, 1944, pages 20, 21, 38, 5 illus.

The Low-Pressure Chamber and Aviation Training. Lt. Comdr. C. F. Gell and Lt. M. C. Shelesnyak. The writers present to nonmedical personnel the possibilities for exploitation of the low-pressure chamber units for aiding in the training of aviation personnel and indoctrinating them in the newer and finer developments in preventive aspects of aviation medicine. *United States Naval Institute Proceedings*, October, 1944, pages 1242–1247, 2 illus.

Warfare

Swedish Rearmament in the Air. Major Bergman. Some notes are offered relative to the organization, expansion, and status of the Swedish air force and aircraft industry. Supplemented by information about personnel, training, numbers and types of planes, and appropriations, the growth of the Swedish air force from a peacetime organization to its wartime dimensions is recorded. The beginning of Swedish manufacture of airplanes and engines is described and attention is called to the special winter conditions under which the Swedish air force must train and operate. *The Aeroplane*, September 29, 1944, pages 364, 365, 6 illus.

Royal Air Force Regiment. This article deals with the organization, functions, tactics, equipment, and training of the Royal Air Force Regiment, the unit charged with the ground defense of R.A.F. airdromes. After reviewing the events leading up to the formation of the R.A.F. Regiment, the article outlines its tactical functions up to the Allied invasion of Europe and then describes its transition from defensive to offensive strategy after the invasion. Particulars are given on the school where, under the direction of the R.A.F. Technical Training Command, personnel for this regiment are trained. *The Aeroplane*, September 29, 1944, pages 356, 357, 6 illus.



Typical aluminum weld beads made by the a.c. helium process. Irregular intervals of good and bad welding were found between 280 and 460 volts, indicating that the true critical voltage for helium was either higher, or that the helium arc was very sensitive to slight changes of gas flow, gas purity, or arc length. Usually, when voltages greater than 380 were used, satisfactory welding conditions were established. *Top*—Good weld bead made at high open circuit voltage. *Bottom*—Weld bead showing how the a.c. helium arc erratically shifts from good to bad welding at low voltages.

Welding

Helium-Shielded Arc Welding of Stainless Steel Exhaust Collectors. Francis H. Stevenson. The welding of 18-8 type stainless steel, which is used in the manufacture of exhaust collectors, is discussed. Consideration is given to the control of carbide precipitation and distortion of the part. Early experiments with the welding of a stainless-steel heat exchanger are described. It was found that the length of time the part is under the welding heat is an important factor in the control of distortion. When the helium-shielded arc process was used instead of the oxyacetylene process the welding time was considerably reduced and distortion was found to be slight. A description is given of laboratory tests that were used to determine the physical and metallurgic results obtained with the oxyacetylene process and the helium-shielded arc-welding process. The welding techniques used in the process are briefly discussed. *The Welding Journal*, October, 1944, pages 873–876, 10 illus.

Salvaging Parts by Welding. A description is given of the Mogul Nervous Weld process, which is stated to be particularly suited for plugging holes in aluminum, bronze, gray iron malleable and steel castings. It is explained that the equipment for the process includes: (1) the Nervous Weld machine, which operates on either 110, 220, 440, or 555 volts, single phase, from the a.c. power line; and (2) the Nervous Weld pistol, which is operated with approximately 6 cu.ft. of compressed air at 40 lbs. pressure. The pistol has feed rolls and a trigger arrangement for manual feeding of the rod. The compressed air also provides a cooling device for the electrode, as well as for keeping the work cool. The process is stated to be particularly useful for salvaging aluminum castings. *Industrial Aviation*, October, 1944, page 67, 2 illus.

Small Portable Condenser Welding Set. E. M. Callender. This article describes a portable condenser welding set suitable for the emergency repair of stainless-steel cargo planes. It is noted that the power plant for a comparable a.c. resistance welding machine must provide at least a 50-kva. output whereas the discharge welder described is used with a 5-kva. power plant. Some discharge welder fundamentals are reviewed, after which the departures from conventional practice, which made possible considerable weight reduction, are explained. Eight advantages of the portable discharge welder and three of its limitations are listed. *The Welding Journal*, October, 1944, pages 882–887, 14 illus.

(*Continued on page 121*)

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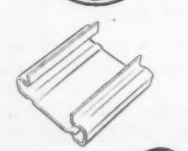

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Government Publications

Army Air Forces

Procurement Division. In the unification of the former Air Service Command and Matériel Command under Lt. Gen. William S. Knudsen and his deputy director, Major Gen. Bennett E. Meyers, one division of the Air Technical Service Command has the functions of buying and supervising production and inspection of aircraft for the Army Air Forces.

Heading the Procurement Division is Brig. Gen. Orval R. Cook. The Procurement Division's deputy chief is Col. Donald C. Swatland. Also on General Cook's executive staff are Mr. W. E. Donnelly, assistant to the chief, Col. H. A. Shepard, chief of the Division's control section, and Major W. T. Tutt, General Cook's administrative assistant.

The Procurement Division has a twofold job. First, it helps A.A.F. headquarters determine what types of aircraft can be produced in quantity to meet the Army's current and anticipated requirements. Second, it procures from the 15,000 manufacturers in the aircraft industry the 450,000 items that the A.A.F. requires, and sees that the schedules and specifications are met.

To accomplish these missions General Cook has organized the Procurement Division's work into three sections—Resources Control, Production, and Quality Control.

The Resources Control Section, headed by Col. George H. Moriarty, determines the quantities of basic materials and semifabricated and standard parts required in aircraft production. It provides for the necessary manufacturing facilities and tooling. Since shortages exist on many of these productive factors, such as materials and tooling, the Resources Control Section arranges priorities on which to allocate the available supply.

Chief of the Production Section is Col. George E. Price, who negotiates, prepares, and administers contracts for the purchase of A.A.F. planes and equipment. His section sees that production is maintained to meet A.A.F. schedules and supervises the modification of aircraft to assure that the planes are equipped with the latest developments in science and engineering. The section also allocates Government-furnished equipment, such as engines, propellers, and radio, to aircraft manufacturers.

Col. Bryant L. Boatner, chief of the Quality Control Section, establishes the policies and procedures under which 14,000 officers and civilians inspect and accept all aircraft, aircraft accessories, and equipment for the A.A.F. *Air Technical Service Command.*

Shooting Landings by Radio. Lt. Col. F. L. Moseley. A nontechnical description is given of the instrument-approach system utilized by the Army Air Forces. It outlines portable and fixed equipment and instruments and their functions and shows how the system is operated for control of traffic and to effect individual landings under difficult conditions. *Air Force,* October, 1944.

Air Pillows to Lift Planes. Standard A.A.F. equipment has been supplemented by pneumatic lifting bags for jacking up aircraft on soft ground and for use in raising crashed planes. The Air Technical Service Command's equipment laboratory provided a device for lacing the bags one on top of another, so that high-wing planes might be lifted to any desired height.

The equipment weighs 220 lbs. and can be carried in most planes. It is furnished in sets consisting of three bags and one gasoline-engine-driven blower. Each bag is 6 ft. high. Only two are required to lift most planes, but a B-24 Liberator takes four and a B-29 Superfortress utilizes eight. Each bag can support 12 tons, measures approximately $6^1/_2$ ft. square and is filled with air at a pressure of 3 lbs. per sq.in. Because this pressure does not exceed the skin strength of an airplane wing, wing damage during lifting is prevented. *Air Technical Service Command.*

The B-29 and You. Major Luther Davis. The selection and training of crews for the B-29 Superfortress bomber are outlined in a description of the operational training as carried out by the 17th Bombardment Operational Training Unit Wing. It describes the characteristics and equipment of that airplane and the special instruction given to the men whose previous experience has qualified them for the handling of this large new bomber. *Air Force,* October, 1944.

Bibliography of Rotary Wing Aircraft is a compilation prepared by the Engineering Division for engineers engaged in rotary-wing aircraft projects at Wright Field. The material is presented under classified headings, but, since the cataloguing was based to a considerable extent on titles rather than on content, many theoretical papers that contribute to helicopter studies as well as to autogiro studies have been listed only under the heading "Autogiros." The first section contains lists of publications concerning helicopters, the second section refers to autogiros, and the third to cyclogiros. The fourth section contains lists referring to gyroplanes, a list of abbreviations, and an index of periodicals. *Technical Data Laboratory, Engineering Division, Air Technical Service Command,* Wright Field.

Airborne Army. Major Charles D. Frazer. A short account reviews preparations made for the invasion of the Netherlands by the Allied Airborne Army. It describes the organization of the unit; its equipment; and the tactics it employed in landing troops, supplies, and equipment back of the enemy lines. *Air Force,* October, 1944.

German Robots Duplicated. Germany's V-1 robot bomb has been exhaustively studied, completely reconstructed, and fired by the Air Technical Service Command, which is seeking effective methods to stop the bomb and use its "secrets" to the Allies' advantage.

Parts used in studying the robot were collected in England. Some were taken from "duds" in which, even though no explosions had occurred, the high speed impact had torn them apart. The first problem was the jet impulse engine. Power-plant engineers studied it and had it running only 17 days after the pieces arrived, despite the fact that it was necessary to fabricate all parts after construction and design had been solved. The complete robot was fabricated and in working condition in less than 2 months after the original parts arrived from England. The parts were machined and assembled in the Command's engineering shops. To make the fabricated engine an exact replica of the German original all metals were analyzed for alloys.

Upon completion, the engine was mounted on a dynamometer stand for test runs. A spark plug was used to ignite fuel for the first several minutes of running, after which heat from the engine provided ignition. Meantime, the Aircraft Laboratory made tests of a robot model in the Command's 5-ft. wind tunnel to determine aerodynamic reaction and characteristics. A full scale impulse engine was also tested in the 20-ft. tunnel to determine speed, thrust characteristics, and fuel-flow rates.

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To give A.T.S.C. engineers a quantity of robots for actual launching tests, component parts are being produced by several manufacturers. Firing tests are to be carried on at sites constructed by the Corps of Engineers. Some of the robots will be fired with war heads provided by the Ordnance Department. Special electrical equipment designed by the Air Technical Service Command Aircraft Radio Laboratory will "track" the robots from launching to final landing. *Air Technical Service Command.*

Fighter Control . . . Nerve Center of Battle. Mark Murphy. A description is given in narrative form of the operations of the Fighter Control Centers of the 9th Air Force. The writer describes how the communications lines are connected to the various operational units that synchronize the movements of the Allied forces in the air and on the ground. They send detailed directions to the planes and the other units with which they cooperate, guiding the entire operation down to the selection of a single enemy truck or airplane to be hit. The activities of a typical day and numerous exploits and accomplishments are recounted. A diagram shows the network of communications and the activities they supervise. *Air Force*, October, 1944.

Get Wise. Lt. Col. George S. Richardson. In the form of seven case histories, the story is told of numerous mishaps that have caused accidents that could easily have been avoided by Air Forces personnel. The anecdotes tell how the accident was caused and how it could have been averted by more careful procedure. *Air Force*, October, 1944.

Civil Aeronautics Administration

Policy Regarding the Use of the Red Warning Light. After air-carrier forward-position lights became available, Memorandum M-75 dated August 28, 1939, stipulated that after January 1, 1940, aircraft would not be certificated as air carrier aircraft (night flying) unless approved air-carrier forward-position lights were installed. That memorandum also stated that all air-carrier aircraft that had been certificated prior to January 1, 1940, with a combination of standard lights plus warning lights, would continue to be certificated, but it was hoped that the standard lights plus warning lights would eventually be replaced by the single set of air-carrier forward lights

However, subsequent events indicated that the tendency to depart from the red warning light was short-lived. The advent of faster airplanes led many pilots to feel that the continued use of a red warning light was desirable since some argued that "the more light the better." Furthermore, the Air Corps continued to install warning lights on its transport-type aircraft, contrary to previous intentions. The Air Carrier Division also feels that the use of such a light is helpful and that many pilots seem to want to continue using it.

In view of an apparent feeling that the red warning light serves a useful purpose, it will be the policy to continue to permit such a warning light to be used if it is already installed on air-carrier or privately owned aircraft, and to permit a new installation to be made, provided the warning light is either in the left landing light orbit or a separate red light is placed in the leading edge of the outer portion of the left wing outside of the propeller disc. *Safety Regulation Release No. 166*, September, 1944.

Minimum Requirements for Carriage of Passengers and Cargo Used in Aircraft in Scheduled Air Carrier Operations. Minimum equipment requirements in addition to those specifically outlined in the current Civil Air Regulations are contained in the currently effective Operations Specifications. Specific directions are given with regard to passenger compartments, passenger seats and seat belts, cargo compartments, and carriage of cargo in passenger compartments. *Safety Regulation Release No. 167*, September, 1944.

Aircraft Engineering Reports. This contains, among other things, a list of available aircraft engineering reports and studies by the aircraft and Engineering Division. It lists 37 reports, some of which are restricted, others confidential, and a few obsolete. The titles and dates are given, together with brief statements of the contents of each report. Available reports are obtainable from the Civil Aeronautics Administration, Division of Information and Statistics Service, Department of Commerce Building, Washington 25.

The usual monthly statistical tables are published giving figures of operations for the month of July, 1944, and for the first 7 months of 1944 as compared with the same period of 1943. *CAA Journal*, September 15, 1944.

The Council of State Governments

Aviation and the States is a mimeographed bulletin divided into three main sections. The first section is titled "Aviation and the States" and contains an interpretive statement prepared by the staff of the Council and originally issued under the title "Washington Legislative Bulletin No. 10" on May 10, 1944. The second section is titled "State Agencies Interested in Aeronautics" and contains information summarized from replies to a questionnaire sent to the various state governments. The information, as of June 1, 1944, is listed alphabetically by states and consists of a brief statement of the existing laws and agencies dealing with aeronautical matters in these states. The third section is a list of "State Agencies Supervising Aeronautics" and contains a list of citations and state laws, also listed alphabetically by states. *The Council of State Governments*, Chicago, $0.50.

Department of Commerce

Hydrographic Manual by Comdr. K. T. Adams is listed as special publication No. 143, revised (1942) edition. It is issued to provide a textbook de-

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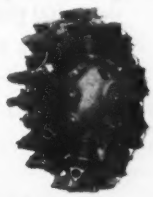

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In the peace to come as in war today, American Bosch research, engineering counsel, production and maintenance facilities will continue to serve all branches of the internal combustion engine industry.

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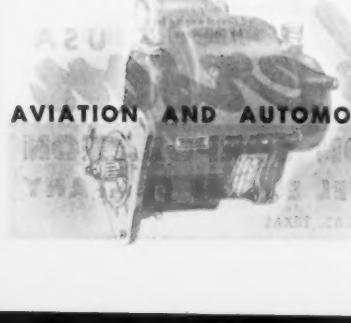

AMERICAN BOSCH

AVIATION AND AUTOMOTIVE ELECTRICAL PRODUCTS • FUEL INJECTION EQUIPMENT

scribing modern methods of hydrographic surveying and equipment. In it are stated the general requirements of the U.S. Coast and Geodetic Survey for the execution of hydrographic surveys. This edition describes in detail for the first time the instruments and methods used in echo sounding and radio acoustic ranging.

The subject matter of the book is identified by a decimal numbering system and the contents are indexed according to these numbers. There are nine chapters, each of which is divided into not more than nine sections. Each section is subdivided into not more than nine subjects, and each subject into not more than nine numbered headings. The first digit of the number identifies the chapter, the second digit the section, the third the subject, and the fourth identifies the heading.

The first chapter gives preliminary information and the following chapters are titled "Control and Signal Building," "Hydrograph," "Equipment and Instruments," "Echo Sounding," "Radio Acoustics Ranging," "The Smooth Sheet," "Records and Reports," and "Miscellaneous." The book contains 190 illustrations and 42 tables of data and statistics. *U.S. Coast and Geodetic Survey.* For sale by the Superintendent of Documents, Washington, D.C., $2.75.

Defense Supplies Corporation

Additional excerpts from Part III of a confidential survey "Air Transportation in Latin America" have been made available. It contains figures showing the relationship of population and national income in various Latin American countries, intended to provide a measure of the relative development of air transportation in these countries and to serve as a guide to an appraisal of the potential volume of air traffic. It is noted that passenger traffic in Latin America is less than one-fifth as great per capita as in the United States, but, in relation to national income, twice as many passenger miles are flown in Latin America. Cargo traffic is half as great per capita, but 15 times greater in relation to national income. The lack of surface-transport facilities is a factor contributing to the probability of the growth of air transport.

Tables give (1) a summary of local traffic per capita and per dollar of national income in 1943; (2) traffic per capita and dollar of national income; (3) miles flown in relation to area, population, and national income; (4) summary of population by countries; (5) area, population, and national income.

It is stated that air lines in Latin America serve 585 cities as compared with only 258 cities in the United States. However, only 17 per cent of the population of Latin America is directly served by air, and there are 973 cities of 5,000 or more inhabitants without air service. Although air transportation has been developed to a relatively high degree in certain countries, many new routes will undoubtedly be needed to serve urban population not now on or close to existing routes. *American Republics Aviation Division.*

National Advisory Committee for Aeronautics

Heat Transfer in a Turbulent Liquid or Gas Stream. H. Latzko. Translation of "Der Waermeuebergang aneinen Turbulenten Fluessigkeitsoder Gasstrom" from *Zeitschrift fuer angewandte Mathematik und Mechanik*, August, 1921. The theory of heat transfer from a solid body to a liquid stream could be presented previously only with limiting assumptions about the movement of the fluid (potential flow, laminar frictional flow). For turbulent flow, the most important practical case, the previous theoretical considerations do not go beyond dimensionless formulas and certain conclusions as to the analogy between the friction factor and the unit thermal conductance. In order to obtain numerical results, an experimental treatment of the problem was resorted to, which gave rise to numerous investigations because of the importance of this problem in many branches of technology. However, the results of these investigations frequently deviate from one another. The experimental results are especially dependent on the overall dimensions and the specific proportions of the equipment.

In the present paper an attempt is made to develop systematically the theory of the heat transfer and of the dependence of the unit thermal conductance on shape and dimensions. As a basis, the writer uses the velocity distribution for turbulent flow set up by Prandtl and von Kármán. The subject is developed under the following headings: Hydrodynamic Principles; Turbulent Thermal Convectivity; The Fundamental Law of Turbulent Heat Exchange; Heat Exchange in Tubes; Heat Transfer for the Case in which the Velocity Distribution Has Been Established at the Entrance to the Thermal Section; Discussion of Results and Agreement with Experiment; The Velocity Field in the "Calming Length"; Heat Transfer in the Entrance Section; Summary and Comparison with Observations; Practical Computation of the Amount of Heat Transferred; Estimation of the Internal Heating of the Fluid by Friction; Heat Transfer on a Flat Plate; Transmission in Liquids.

The study is supplemented by a list of references and a series of explanatory notes by the translators, as well as the various drawings and tables referred to in the text. *Technical Memorandum No. 1068*, October, 1944.

National Bureau of Standards

A New Formula for Inverse Interpolation. H. E. Salzer. In this paper a formula is derived for inverse interpolation in a table of equally spaced arguments. The new formula is stated to be more concise and convenient than others. It involves neither differences nor polynomial coefficients other than small powers. Reprinted by the National Bureau of Standards from the *Bulletin of the American Mathematical Society*, August, 1944.

Navy Department

War Films for War Workers. This booklet, issued jointly by the Army and Navy, describes methods being used in showing special battle-front films in war plants and other meeting places. Suggestions are included for utilizing local theaters, parks, and other open spaces for similar showings. A section of the booklet discusses appropriate times for such industrial showings, and also contains suggestions on how to publicize these events. The booklet includes information about how Army and Navy films may be obtained for industrial showings. *Industrial Incentive Division, Navy Department*, Washington, D.C.

State of Michigan

The Michigan Board of Aeronautics and representatives of various city and county governments in southeastern Michigan have formed the Detroit Metropolitan Aviation Planning Authority for the purpose of planning facilities for civil aviation in the Detroit metropolitan district and surroundings. Funds have been provided by the state board to finance an engineering analysis of existing aviation facilities within a radius of 40 miles of downtown Detroit and to plan additional facilities to accommodate present and postwar aviation up to 1960.

The Authority desires to make contact with firms competent to provide this service. *Michigan Board of Aeronautics*, Lansing, Mich.

State of Vermont

State of Vermont Aeronautic Laws is a small booklet of 38 pages containing a digest of the laws of that state governing the operation of aircraft within its territory. It is indexed under headings of administration, airport development, definitions, Federal legislation, legal status, operation of aircraft, penalties, and registration and licensing.

War Department

Airplane Hydraulic Systems gives elementary explanations of hydraulic principles and their applications. This

HOW
Flex-O-Tubes
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AUTOMATIC PILOT ACTUATION
BOMB DOOR CONTROLS
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COWL FLAP CONTROLS
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FUEL AND OIL LINES
GUN MOUNT CONTROLS
HYDRAULIC BRAKES
HYDRAULIC GUN CHARGER
HYDRAULIC GUN TURRETS
HYDRAULIC RUDDER CONTROLS
HYDROMATIC PROPELLER CONTROLS
INSTRUMENT LINES
OXYGEN FEED LINES
PUMP CONNECTORS
RETRACTABLE LANDING GEAR
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is followed by other sections giving detailed information about the various units comprising the different parts of a hydraulic system, such as the energizing and activating units, brake, actuating systems, various types of control valves, and instructions for the inspection and maintenance of hydraulic systems. The manual is illustrated by drawings, some of which are colored to distinguish the different elements. *Technical Manual TM 1-411*, May, 1944. For Sale by the Superintendent of Documents, Washington, D.C., $0.25.

Barographs ML-3-A, ML-3-B, ML-3-C, ML-3-D. This manual gives a detailed description of the specific barographs named, including instructions for installation, operation, and maintenance, as well as a section describing the functioning of the parts of the instrument. *Technical Manual TM-425*, July, 1944. For Sale by the Superintendent of Documents, Washington, D.C., $0.10.

British Air Commission

The Fairey Firefly is a new heavily-armed fighter-reconnaissance aircraft, used in first-line service with the Royal Navy. It scored its first success in a recent operation against the German battleship *Tirpitz* in Alten Fiord in northern Norway.

Fitted with four 20-mm. cannon, the new aircraft is a low-wing monoplane equipped with a camera for vertical aerial photography. The wings are of the folding type. The engine is a 12-cylinder, liquid-cooled Rolls-Royce Griffon.

The Firefly carries a crew of two, pilot and observer. It has a span of 44 ft. 6 in., a length of 37 ft., and a height of 13 ft. 7 in. It was designed by Fairey Aviation Company, Ltd.

The Tempest. The Tempest is a single-seater, low-wing monoplane fighter produced by Hawker Aircraft, Ltd. It is powered by a supercharged Napier Sabre engine of 2,200 hp. and has a de Havilland variable-pitch, four-bladed propeller. The armament consists of four 20-mm. cannon.

Dimensions are as follows: span, 41 ft.; length, 33 ft. 8 in.; height (tail up, one blade vertical), 14 ft. 10 in.; height (tail down, one blade vertical) 16 ft. 1 in. *British Air Commission*, Washington, D.C., *British Information Services*, New York.

British Information Services

Wood Stringer Sandwich Construction. Part I, The Efficiency of Wood Stringer Sandwich Construction When Subjected to Endwise Compressive Loading, by F. T. Barwell; Part II, The Behaviour of Wood Stringer Sandwich Construction Under Shear Stresses, by F. R. Thurston and E. P. Coleman. A limited investigation is made of the strength and stability of a sandwich construction consisting of two faces of birch plywood stabilized by wood stringers. Experiments are described with regard to the load-carrying capacity of struts of various lengths. Measurements are made of the modulus of rigidity and shear strengths of a number of panels having various arrangements of grain and stringer construction.

It is concluded that (1) the arrangement offers considerable promise as a method of construction in cases where comparatively light compressive loads are to be transmitted over large panels, and (2) the stabilization of the plywood by stringers supplied at 10-in. intervals is such as to permit shear stress of the order of $2^1/_2$ tons per sq.in. to be developed before buckling takes place. In the majority of cases the plywood may be expected to fail in shear or tension before the panel faces become unstable.

The report is accompanied by sketches and graphs, and the results of the tests are tabulated. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1911*, British Information Services, New York, $0.90.

British Ministry of Information

The Army at War: Tunisia contains brief reviews of the military action in Tunisia, starting with the landings in North Africa and ending with the collapse of the Axis armies. It is extensively illustrated with official photographs showing the various actions and the kind of country in which they took place. Several maps are included. Many of the illustrations show the participation of the air forces. *His Majesty's Stationary Office*, London, 1*s*.

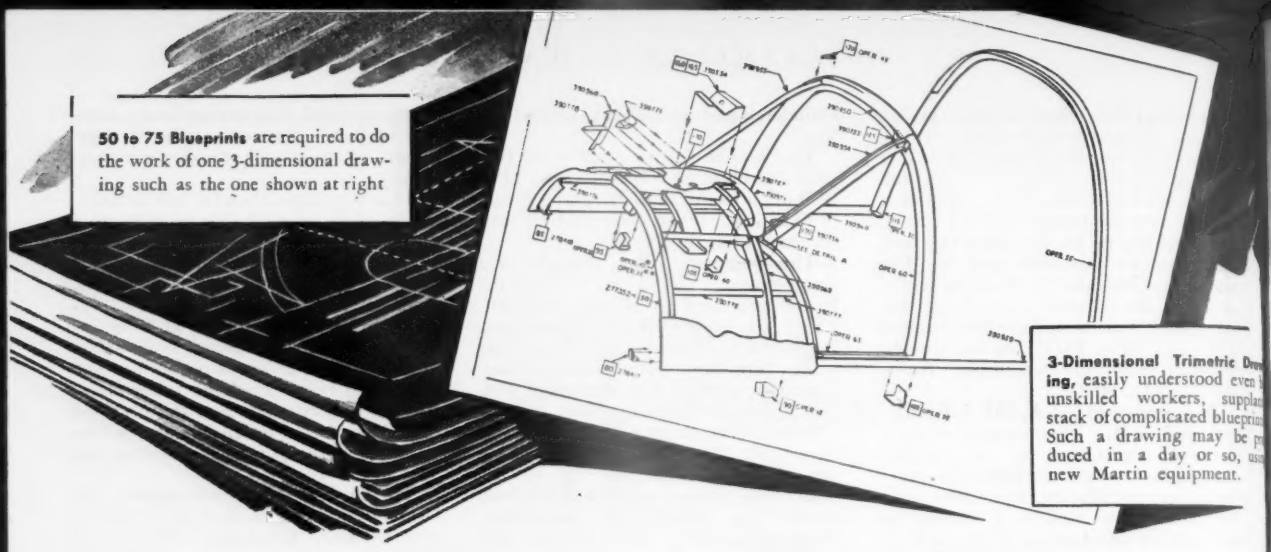
(*Continued from page 113*)

Roll Gun Welders Fabricate Steel Jettison Tanks. John C. Silliman. A step-by-step description is given of the planning required for economical tooling for the resistance welding of fabricated steel jettison tanks. Details are given about the special portable roll welding guns and the fixtures used by Preco, Inc., Los Angeles. The 150-gal. auxiliary tanks were designed for the P-51. Information regarding the spot-weld cost analysis and tooling analysis is presented in tabular form. Sections of the article discuss the skin stiffener fixtures, the welding apparatus necessary for the operation of the fixture which was built up as a unit called a power pack, the bulkhead fixtures, the positioning of the back-up bors, and the features of the portable roll gun welder. *The Iron Age*, October 12, 1944, pages 67–73, 10 illus.

Characteristics of Welding Arcs on Aluminum in Atmospheres of Helium and Argon. F. A. Wassell. A report is given of an investigation, based on the principle of gas-shielded arc welding utilizing inert gases such as helium and argon, which has been in progress in the General Electric Welding Laboratories for the purpose of developing a process that would eliminate the use of flux in the welding of aluminum. The paper sets forth some of the unusual and interesting phenomena observed during the investigation.

Conclusions regarding the gas-shielded arc welding of aluminum without the use of flux in the atmospheres of argon and helium which were reached through the investigations are: (1) The success or failure of arc welding aluminum without a flux depends primarily upon the proper dispersion of the surface oxide film by the arc. (2) Alternating-current welding can be accomplished provided the open-circuit voltage is above a range in which complete rectification of the current occurs. (3) Direct-current welding can be accomplished when the electrode polarity is positive; (4) Helium-shielded arc welding with both a.c. and d.c. is less desirable than a.c. and d.c. welding in argon. (5) Essentially, a short arc length must be maintained in order to provide a good stable arc and a clean weld pool and bead. (6) Limitations must be placed on the quantity of gas flow because of its effect on arc stability and weld appearance, particularly in direct-current welding. (7) The electrode material should be substantially nonconsuming. (8) In general, a.c. welding is less critical and better suited to manual welding than is d.c. welding. *The Welding Journal*, October, 1944, pages 487-s–493-s, 15 illus.

The Geometry of the Spot-Welding Tip and Its Relation to Tip Life. Earl D. Crawford and C. Weston Steward. Details are given about an investigation conducted with the object of obtaining longer tip life which would reduce production costs and provide more uniform quality spot welds in aluminum alloys. The development of a specially contoured tip is stated to have shown the most consistent improvement in spots-per-tip cleaning so far achieved. The development of a tool that would automatically produce the flat-end raised button, which was the feature of the new tip, is described. The results obtained are summarized. *The Welding Journal*, October, 1944, pages 494-s–498-s, 11 illus.


50 to 75 Blueprints are required to do the work of one 3-dimensional drawing such as the one shown at right
3-Dimensional Trimetric Drawing, easily understood even by unskilled workers, supplants stack of complicated blueprints. Such a drawing may be produced in a day or so, using new Martin equipment.

New Martin Devices Prepare Trimetric Drawings IN 50% TO 80% LESS TIME!

FOUR new drawing instruments and an almost human mechanical draftsman, which promise to revolutionize the entire field of production illustration and assembly drawings, are the latest in the parade of "firsts" to emerge from Martin laboratories. Already used by Martin in construction of the JRM-1 Mars transports, these new devices prepare these drawings in 50% to 80% less time than less accurate three dimensional drawings.

Simplifies Assembly Work

In addition to being quickly prepared, the three-dimensional drawings . . . known as trimetric projections . . . present objects with a minimum of distortion, thus making complicated parts easily understandable to even unskilled workers. For years such drawings have been restricted to a few highly specialized operations due to the prohibitive cost of producing them. Now, however, thanks to the new Martin devices, trimetric projections may be produced far more quickly and at far less cost. More, they may be produced by relatively inexperienced draftsmen.

Unusual New Equipment

Martin equipment for producing these three-dimensional drawings consists of five devices. Most important is the Axonograph which transforms orthographic, or flat drawings, into scale axonometric projections. Four other Martin-developed devices help draftsmen convert axonometric projections into finished trimetric projections: a trimetric scale, an ellipse template, an ellipse underlay and a trimetric protractor.

Many Uses Seen

In addition to its use in aviation, this equipment will be of inestimable value to engineers, architects, assembly plants of all types, installation mechanics, even advertising and commercial illustrators. Where many flat drawings are now used, quickly-prepared, easy-to-understand trimetric projections can make explanation and demonstration easier and time saving. The expense and difficulty of training inexperienced personnel to read blue prints is also greatly reduced. Companies interested in the Martin Axonograph and the new Martin drawing instruments write:

The Glenn L Martin Company
Baltimore 3, Maryland

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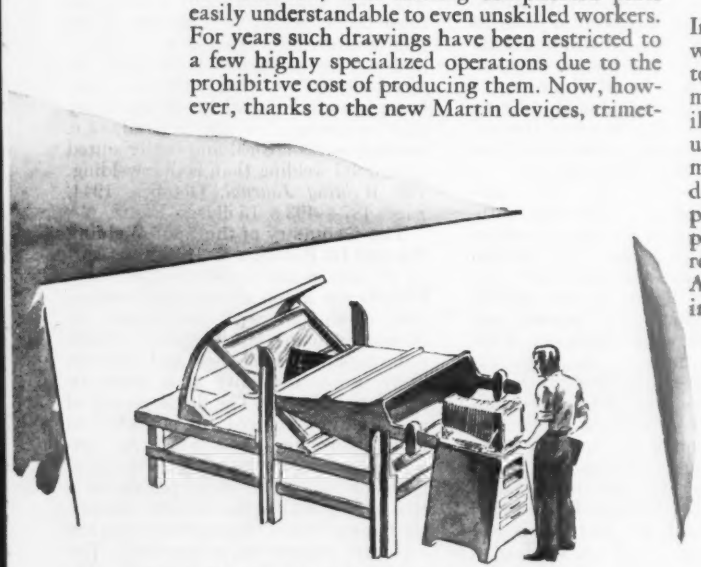


Martin Axonograph cuts time required to produce axonometric prints, permits work to be done to an accuracy of 4 decimal points by a semi-skilled operator.

BOOKS

Winged Peace

Air Marshal William A. Bishop

Contents: The New Geography; Wings and the Man; The Years of Growing Pains; Ordeal by Air; Where Do We Go From Here?

One of the leading aces of World War I, who was credited with destroying 72 German aircraft, writes of his own experiences, of his associates, of the present war, and of world air transport. He gives his opinions and suggestions for bringing winged peace instead of what he calls winged death.

No one can speak of the air warfare in World War I with more personal experience than the author and he relates his views with great positiveness. His contact with commercial aviation has given him definite ideas as to its great possibilities in the future.

He feels that people who do not take into consideration the new geographical concepts of world air routes and new technological developments are "a pack of stupid fools." He regards rockets and jet propulsion as factors of paramount importance.

After reviewing the trends of military aviation and the great expansion of world air transport, with particular attention to Canadian aviation, he gives his conclusions as to the operation of postwar global air routes. He presents his arguments for world operation of the world airways by an international organization that would direct as well as operate all the air lines of the world. He advocates cooperation by all nations in an international air force to preserve peace and prevent future wars. He goes further and states that "no manufacturer of military aircraft can be allowed to manufacture military air equipment for anyone but the World Air Force." The Viking Press, New York, 1944; 175 pages, $2.75.

Skyways of Tomorrow

Burnet Hershey

Contents: Technical Possibilities of Modern Aviation; Probable Routes of Commercial Transport; Air Bases; Aviation in International Law; Ownership and Operation of Commercial Routes; Air Age Scrapbook—1909.

This pamphlet is one of a series issued by the Foreign Policy Association. It is stated that the information is "unbiased"; the author apparently believes that being pessimistic is being "unbiased." His discussions about commercial air transport, air bases, and the international aspects of aviation are an excellent review of the present confused status of this world development.

There is a concluding chapter by Houston Peterson on an old scrapbook that inaccurately states that Wilbur Wright flew in Berlin while the Rheims meet was going on, and that in New York Orville Wright flew from Governor's Island on September 29. The reverse is true: Orville Wright flew in Berlin during August and September, 1909, and it was Wilbur Wright who made the Hudson-Fulton Flight. Reference to any book on the history of the Wright brothers would have prevented such misstatements. Such careless reports of historic flights should be checked before being allowed to appear under the imprint of such an important organization. Foreign Policy Association, New York, 1944; 96 pages, $0.25.

With the exception of aeronautical annuals and books published outside the United States, books reviewed in this section may be borrowed without charge from The Paul Kollsman Library of the Institute of the Aeronautical Sciences, 1505 RCA Building West, 30 Rockefeller Plaza, New York 20, N. Y.

Rocket Research

Constantin Paul Lent

Contents: Definition and General History of the Rocket; Early Research; Résumé of Early Experiments by the American Rocket Society; The Theory of Rocket Operation; Practical Application of the Jet-Propulsion Motor; Practical Hints to Experimenters; Potential Advantages of Hot Air Jet-Propulsion; Summary of Advantages of Hot Air Jet-Propulsion.

The author has made a lengthy study of rockets and presents a history of their development. He describes early research and some of the work done by the American Rocket Society. His theory of rocket operation and his hints to experimenters will be helpful to those who are engaging in the study of this interesting new propulsive force.

Chapters give the application and advantages of the jet-propulsion engine, and an appendix lists some of the leading American rocket patents. The illustrations in the book are a helpful aid in following the course of the history of rockets. Unfortunately, the evident amateurish editorial style and careless proofreading would indicate that this book suffers from a lack of critical supervision and editing. Pen-Ink Publishing Company, New York, 1944; 102 pages, $5.00.

Comfortization of Aircraft

Albert A. Arnhym

Contents: Introduction; The Comfort Accessory Group; Selection of Comfort Features; Planning of Comfortization; Comfortization Standards; The Comfortization Engineer; Requirements of Air Supply; Methods of Air Supply; Methods of Air Distribution; Calculation of Ventilating Systems; Selection of Air Supply; Requirements of Heat Supply; Calculation of Heat Requirements; Methods of Heat Supply; Internal-Combustion Heaters; Theory of Exhaust-Gas Heat Exchanger; Selection of Heat Supply; Fundamentals of Soundproofing; Soundproofing of Aircraft; Seating and Resting; Lighting; Fighting Comfort; Compartment Comfort.

The comfortization of both military and commercial aircraft is dealt with in this book. All of the equipment required for comfortization, which may be regarded as a single accessory group, is discussed in this extensive treatment. Consideration is first given to factors affecting the selection of comfort features and to planning for comfortization.

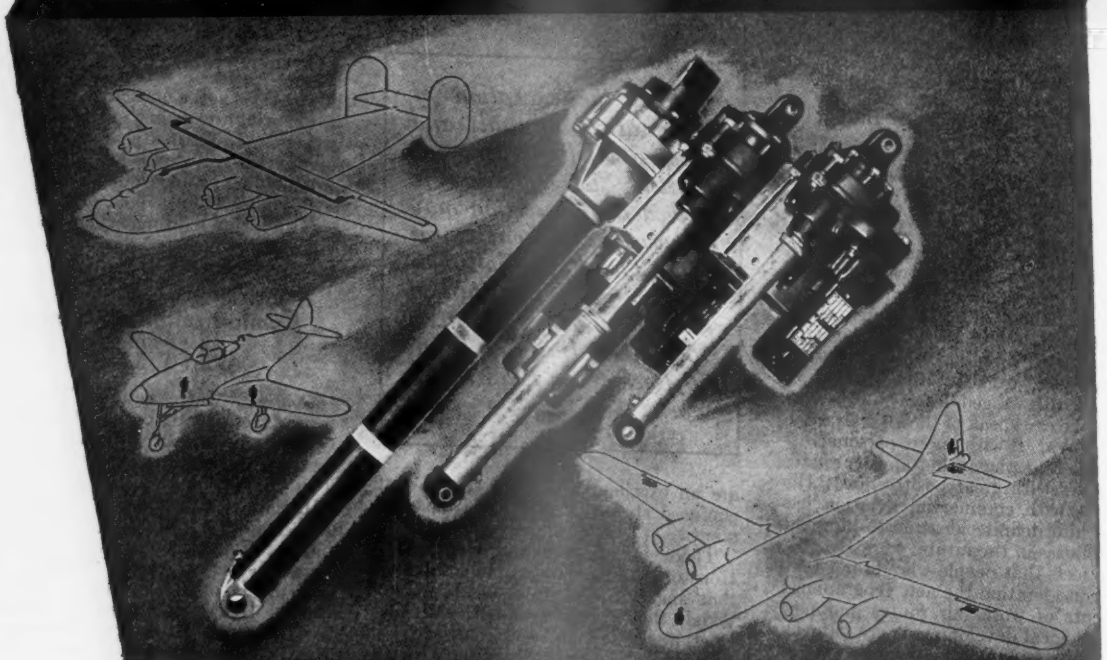
The qualifications of the comfortization engineer are discussed. A considerable part of the book is devoted to the subjects of air and heat supply. The soundproofing of aircraft is discussed in detail. Other sections deal with aircraft lighting, and the provision of comfort for the fighting crews in military planes. Pitman Publishing Corporation, New York, 1944; 347 pages, $7.50.

Partial Differential Equations of Mathematical Physics

H. Bateman

Contents: The Classical Equations; Applications of the Integral Theorems of Green and Stokes; Two-Dimensional Problems; Conformal Representation; Equations in Three Variables; Polar Co-Ordinates; Cylindrical Co-Ordinates; Ellipsoidal Co-Ordinates; Parabo-

Muscles for America's Aircraft



TWO LOWER landing gears, to open and close shutters, to raise and lower flaps, airplanes need muscles. They must be sure-fire, smooth and precise in their action. They must be strong and dependable.

Here you see such muscles. They are Lear Actuators.

These Actuators are powerful, yet operate on a plane's limited electric current. They're tough and strong, yet tip the scales in ounces or paltry pounds. They can be started and stopped with a simple switch or can be completely automatic.

Devices such as these, tried and proved under the extreme stresses of war, will prove equally important on the great new airplanes which lie ahead in peace.

Lear engineers stand ready to contribute their experience with the use of such controls. Feel free to call upon them whenever a control or actuating problem arises.

PLANTS: Piqua, Ohio, and Grand Rapids, Michigan
BRANCHES: New York, Los Angeles, Chicago, Detroit, Cleveland

Lear INCORPORATED

Formerly Lear Avia, Inc.

loidal Co-Ordinates; Toroidal Co-Ordinates; Diffraction Problems; Non-Linear Equations.

This is the first American edition of an English work on the solution of the boundary-value problems of mathematical physics by means of definite analytical expressions. The book has been written for engineers, including those working in aeronautical research; mathematicians; and physicists. It contains a wide range of representative problems, references to contemporary literature, and new results by the author. Dover Publications, New York, 1944; 522 pages, $3.95.

Gliding and Soaring

John Paul Andrews

Contents: The Case for the Glider; Fifty Years of Silent Flight; From Kitty Hawk to Crete; The Why of Gliding; What Glider Shall We Buy?; The Methods of Launching; Instruments of Gliding; Glider-Club Prospects and Problems; Flying the Primary Glider; Flying the Secondary Glider; Flying the Sailplane; Natural Elements of Soaring; Currents for Soaring; Balancing the Glider-Club Budget; The Future for Gliders.

Written to furnish a basic approach to an aeronautical youth-training program, this book deals with gliding in its various phases, including gliding as a sport, as prepowered flight, and as an educational project. A short course in elementary aerodynamics is included. The author tells in simple terms what makes the glider fly, how it manages to stay aloft, and how to take advantage of the glider's structure once it is aloft. Types of gliders are described, with elementary instruction in building them, and the distinction between gliding and soaring is made clear. The technique of flying gliders is explained and a chapter is devoted to instruments and instrument flying. A section is included on gliding clubs and the method in which schools can operate them for their sport and educational values. Robert M. McBride & Company, New York, 1944; 190 pages, $2.75.

Astronomical Air Navigation

Ronald Hadingham

Contents: Preliminary Study; Procedure; Star Identification; Practical Work in the Air; Further Study; P.Z.X.; Astronomy; The MK. IX Sextant; Star Curves.

The author's purpose in writing this handbook for practical navigators, instructors, and students was to provide a complete course in astro-navigation, with only essential references to the mathematical and theoretical aspects. Because the student must have a knowledge of basic principles as a foundation in order to understand the subject fully, such principles are included in the book, as well as a certain amount of astronomy that will help the navigator to appreciate the nature of the heavenly bodies and their movements. Astronomical navigation tables and extracts from the Air Almanac are given in an appendix. The Thomas Y. Crowell Company, New York, 1944; 132 pages, $2.50.

Aeroplane Flight

H. F. Browne

Contents: Lift; Stalling; Drag; The Atmosphere; Thrust; Performance; Control; Stability; Units; Models.

This textbook for readers with a limited knowledge of the mechanical sciences offers simplified explanations of some of the mechanical facts governing the flight of an airplane. Each new mechanical principle is explained in detail when it is first introduced in the text. From elementary mathematical principles, the student is led on to lift and drag coefficients and Reynolds Number in such a manner that his mathematical and mechanical ideas do not contradict each other. One hundred eighty diagrams illustrate the aerodynamic fundamentals discussed. Longmans, Green & Company, Inc., New York, 1944; 167 pages, $1.14.

Book Notes

MacArthur and the War Against Japan, by Frazier Hunt; Charles Scribner's Sons, New York, 1944; 182 pages, $2.50.

Following General MacArthur through his work for the Phillipine army, his escape from the islands, his defense of Australia, and finally his gradual moves toward Japan is one of the most heroic, dramatic, and inspiring chapters of the war.

Related by one of the best-known correspondents, who knew the general well and had access to the official records, the book is a straightforward and comprehensive account of operations in that theater up to the landings in Hollandia in April, 1944.

Major Gen. George Kenney is often mentioned in connection with the important work performed by the air forces in these operations. MacArthur regarded Kenney as "the finest air commander he had ever known" and Kenney said of his chief, "He knows more about the strategic handling of air forces and has more imagination in their use than any commander in the world."

Brave Men, by Ernie Pyle; Henry Holt and Company, Inc., New York, 1944; 474 pages, $3.00.

Ernie Pyle's human approach to any subject is what makes him unique among columnists. In this book he tells stories of the Mediterranean Allied Air Force and particularly of the 12th Air Support Command, which operated dive bombers in the North Africa area. No other writer seems to catch so well the spirit of the enlisted man and to describe so vividly his inner thoughts.

The author lived with the 47th Light Bomber Group and shared their experiences. He tells of their life and combat work. Later he went to England and visited the Ninth Air Force, which used B-26 Marauders. His description of his flight with them is an excellent portrayal.

Europe; An Atlas of Human Geography, by Marthe Rajchman; William Morrow and Co., Inc., New York, 1944; 120 pages, $2.00.

Every airman who flies European air routes needs a compact gazetter where he may find information about the geography, people, industries, and natural resources of the countries he visits.

This compact atlas gives these facts in clear and nontechnical language, supplemented by maps, charts, and diagrams. It will also be useful to those who wish to have a broader knowledge of European human geography.

War Through the Ages, by Lynn Montross; Harper & Brothers, New York, 1944; 941 pages, $5.00.

Written for the professional soldier, as well as those who wish to have a thorough background of the history of warfare, this book of nearly a thousand pages traces the development of military strategy, tactics, and weapons from earliest recorded history through June 9, 1944. It is an attempt to tell the story of warfare in such a way as to give it a meaning for the civilian, who today is a participant of war no less than the soldier.

Air power takes its place in the record, and its great influence on the older branches of the service is indicated.

Art in the Armed Forces, edited by Aimée Crane; Charles Scribner's Sons, New York, 1944; 232 pages, $5.00.

This pictorial record of World War II has the great advantage over photographic histories of reproducing only sketches and paintings portraying incidents that could never be recorded by the camera.

The selection is admirable and the range is from horror to humor. The pictures portray action in all theaters of the war and show many other phases of the activities of the men and women of the services. They depict life in camp and aboard ship; various war posters; scenes in foreign lands; types of soldiers and sailors; and portraits of distinguished officers. The 270 reproductions include many drawings of the Air Forces in action.

Invasion! by Charles Christian Wertenbaker; D. Appleton-Century

SINCLAIR 100-OCTANE FOR NEW SKY GIANTS

Interior View of New Douglas Super Airliner

5-MILE-A-MINUTE SPEED in huge 4-engined, 50-passenger planes! That's planned for transportation over the post-war air routes. These great planes will require super-gasoline. SINCLAIR 100-OCTANE, now devoted to war uses, will be available for the new sky giants . . . and for the further development of civilian aviation.

SAFE FROM THE JUNK YARD – but neglect and excessive wear are sending 280 cars there every hour. SINCLAIR-IZE for WINTER service will help your car to last till a new one is available. See your Sinclair Dealer today.

AMERICAN AIRLINES Flagships at an air terminal. They use Sinclair Pennsylvania Motor Oil. American has contracted for huge new Douglas 4-engined planes for passenger service.

Company, Inc., New York, 1944; 184 pages, $2.50.

This is the story of 3 weeks of the war, telling in great detail of the invasion of Normandy. It weaves into the great plans of invasion the pattern of the Air Forces and the excellent work they did in providing an umbrella for the landings. Written by an eyewitness, it is a connected story of the greatest military, naval, and air operation in history.

Britain in the Air, by Nigel Tengye; Hastings House, New York, 1944; 48 pages, $1.25.

This is a brief review of the history of flying, with emphasis on the work of the British experimenters. It is illustrated with color prints and engravings that are rendered beautifully. The author is a well-known figure in English aeronautical circles and, with a pardonable national pride, he gives in interesting style the story of man's struggle to fly.

For any one who wishes a quick survey of how the airplane was conceived and grew to its present great position in world affairs, the book will serve as a succinct review.

G. I. Songs; written, composed and/or collected by the men in the service, edited by Edgar A. Palmer; Sheridan House, Inc., New York, 1944; 254 pages, $2.00.

The songs that are cheering our troops, sad, humorous, and ribald, are collected in a series which will be of interest to many relatives at home who like to know what their husbands, sons, and sweethearts are thinking while away from home.

Songs are playing an even more important role in this war than in previous history because of the U.S.O. shows. The War Department says, "A singing Army is a fighting Army." This book shows that the soldiers and sailors have a wide choice for their vocal enjoyment.

Men of Science in America, by Bernard Jaffe; Simon and Schuster, New York, 1944; 600 pages, $3.75.

Biographical sketches of 19 scholars who have been prominent in the development of scientific advances in this country are presented in this history.

One chapter is devoted to Samuel Pierpont Langley. It describes his activities in many scientific fields, including his aeronautical investigations. Included also in this chapter is a story of the work of the Wright Brothers. It is unfortunate that many of the statements made were taken from sources that have been found to be inaccurate. Before Fred Kelly's book "The Wright Brothers" was written there was no reliable source of this early aeronautical history. Now, however, that this record is available and the Smithsonian-Wright controversy has been settled, there is little excuse for a repetition of the views of prejudiced writers.

The Island, by Capt. Herbert L. Merillat; Houghton Mifflin Company, Boston, 1944; 283 pages, $3.00.

This may be termed an official history of the First Marine Division on Guadalcanal from August 7 to December 9, 1942. It gives a factual account of the operations of Marine Corps aviation in the defense of Henderson Field, one of the epic defenses of the current war.

R.A.F.'ing It, by "L. A. C. Errant"; Frederick Muller Ltd., London, 1943; 48 pages, 1*s.*

A pamphlet written from a semihumorous point of view of the routine of a Royal Air Force recruit from his first days until the time he became "active."

It is interesting to the American reader to observe the great similarity of the process in England to that of our Air Forces.

Nancy Naylor: Flight Nurse, by Elisabeth H. Lansing; Thomas Y. Crowell Company, New York, 1944; 167 pages, $2.00.

A stewardess on a commercial air line decided to become an Army flight nurse and this book relates her experiences. Her years of flying stood her in good stead and she became a lieutenant in the Army.

She saw hospital life behind the lines in North Africa, and while there continued her romance with a bomber pilot. She flew over the battlefields of Sicily and attended the wounded. It is the story of a new type of Army officer who is rendering gallant services to our airmen.

Signpost to the Stars, by F. E. Butler; George Philip & Son, Ltd., London, 1944; 32 pages, 1*s.*

This pamphlet, a guide to the stars for the novice, shows the principal groupings of stars and describes them. It is the simplest possible presentation of that part of astronomy that interests the public.

Geometrie der Gewebe (Geometry of Webs), by Wilhelm Blaschke and Gerrit Bol; Verlag von Julius Springer, Berlin, 1938; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 339 pages, $9.25.

This is a text book on topological problems of differential geometry. It is divided into three chapters: (1) The Most Simple Webs; (2) Theory of the Invariants of Webs; and (3) Abel's Theorem in the Geometry of Webs.

The book is written in such a manner as to enable advanced students of mathematics to read it without much difficulty. The requirements for an understanding of the subject include the rudiments of the principles of the differential and integral calculus, some knowledge of vector analysis and determinants and their application to projective geometry (duality principle), and a knowledge of those simple statements of partial differential equations in general use.

Airman's Wife, by Renée Shann; Random House, New York, 1944; 202 pages, $2.00.

This love story centers about a base of the British Fleet Air Arm. Its heroine is a member of the Women's Royal Naval Service.

The Testing of Aero Engines, by R. A. Beaumont; Sir Isaac Pitman & Sons, Ltd., London, 1943; 121 pages, 7*s.* 6*d.*

The author has prepared this book for ground engineers and aeronautical students, many of whom have not had the opportunity to acquire practical experience in engine testing, because there has been a lack of detailed information primarily intended for those not fully acquainted with the subject. The text matter is also intended to supplement practical experience by reviewing the general principles governing the testing of engines and the subsequent calculations of power output, especially for supercharged engines.

After a general discussion of the considerations involved in engine testing, the remaining chapters give specific information concerning dynamometers, test-house instruments and accessories, tests on normally aspirated engines, tests on supercharged engines, and testing with a calibrated propeller or fan. An appendix contains tables and graphs relating to engine power at different altitudes, and calculations of pressure and density ratios.

New Airports and the Aviation Industry; Ford, Bacon & Davis, Inc., New York, 1944; 11 pages.

This leaflet contains a compilation of the factors to be considered in the planning of airports for communities, and then proceeds with a discussion of each of these factors. Sections deal with the basis of airport design, passenger traffic and its growth, cargo traffic, the selection of the airport site, and the plan of development.

Aviation's Sketch Book of Aircraft Design Detail; McGraw-Hill Book Company, New York, 1944; 112 pages, $0.50.

Included in this second and revised edition of a sketchbook on aircraft design are drawings that give a well-rounded picture of the constructional details of the components of many types of aircraft, engines, and armaments.

The binding is in loose-leaf style to permit the addition of sketches as they appear from time to time in the magazine *Aviation.*

Airplane Design, by Karl D. Wood; Purdue University, Lafayette, Ind., 1943; 421 pages, $4.50.

The seventh edition of a text on airplane layout and stress analysis calculations, in which particular emphasis is placed on the economics of design. The book shows how airplanes are designed and contains in appendix form most of the data necessary for a student to carry a design project through its preliminary stages.

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The GENERAL AIRPLANE TIRE

A Guide to Naval Strategy, by Bernard Brodie; Princeton University Press, Princeton, N.J., 1944; 314 pages, $2.75.

The third edition of this excellent study of naval strategy makes clear the great changes that have occurred since air power has been brought to bear on sea power. The events since the previous edition was published have necessitated such a thorough revision as to make it almost a new book. The chapter titled "The Air Arm of Sea Power" has been completely rewritten. Although the book is written by a confirmed believer in the ultimate emergence of sea power from its present inferior position, the author nevertheless gives the airplane credit for exerting a profound and as yet unpredictable effect on the future of the battleship, cruiser, and other naval craft.

The indispensability, as well as the vulnerability, of the aircraft carrier is clearly stated. The great change in naval strategy that has resulted from the advent of the airplane is acknowledged, but its limitations from a naval point of view are emphasized.

For the layman it is probably the most readable book on the nature and function of sea-air power that has been written. The absence of technical terms and the evident desire of the author to indoctrinate his readers with sound naval principles make it a book that will render a service by its evaluation of the present status of the sea-versus-air controversy.

I Went to the Soviet Arctic, by Ruth Gruber; The Viking Press, New York, 1944; 285 pages, $3.50.

As Siberia may become one of the important crossroads of world air transport, familiarity with air routes and living conditions in this Arctic region will by helpful to pilots and passengers alike.

This book tells the story of a trip by air from Moscow to Igarka, the new city on the Yenisei River that was built by the Northern Sea Route Administration. The author, a correspondent of a New York newspaper, gives the observations of a trained writer, and her account provides useful information about flying conditions to this midway point on the route to the Pacific.

Her impressions of the life and habits of the people are the results of special privileges she was accorded to study living conditions in the Arctic. She writes objectively, and successfully shows the great possibilities of the hitherto inaccessible region being opened by air routes.

Combat Correspondent, by Lt. Jim Lucas; Reynal & Hitchcock, New York, 1944; 210 pages, $2.50.

A brilliant young newspaper man joins the Marine Corps to become a combat correspondent. He has to undergo the same training as any other fighting marine, and does his writing after he has completed routine duties.

The marines are unique in having this type of soldier. The resulting accounts by such correspondents have a more intimate and realistic interest than those of the observer who looks on but does not participate. This thoroughly enjoyable story of South Pacific operations gives a close-up view of the life of a marine.

Poland Fights Back, by Xavier Pruszynski; Roy Publishers, New York, 1944; 191 pages, $2.50.

This is another story of the fighting Poles. Even the tiny navy of Poland is credited with extraordinary feats. The land army of Polish soldiers fought in Syria and in Italy, always with a gallantry that brought them praise. The record of the pilots in the Polish squadrons attached to the Royal Air Force is well known, but this book tells the story as only a native of Poland could relate it.

My Fighting Congregation, by Chaplain Capt. William C. Taggart and Christopher Cross; Doubleday, Doran & Company, Inc., Garden City, N.Y., 1943; 176 pages, $1.57.

Approached from a chaplain's point of view, this account to air warfare in the South Pacific area emphasizes the care of the dying, the wounded, and the convalescent.

The duties of a chaplain are many, especially where the needs for assistance are urgent. His religious work is carried on under the most trying conditions. He looks after the physical as well as the moral welfare of the troops. He writes to the families to let them know how their sons and husbands meet their end. The book is the account of the life and duties of a chaplain working under the most difficult conditions.

Identification; The Military Service Publishing Company, Harrisburg, Pa., 1943; 323 pages, $2.00.

The need for a book giving the identification of insignia and uniforms of the world military, naval, and air forces is obvious. This book is also a gazetteer of each country and gives translations of terms that will prove useful to our officers and soldiers as they travel from country to country. The insignia and uniforms are shown by illustrations so that they may be easily recognized when seen on members of foreign armed forces.

It will be of great assistance to intelligence officers, to airmen who are going on foreign service, and to civilians who wish to solve the mysteries of the complicated system of identification of uniform and insignia.

Aviation in Miniature, edited by D. A. Russell; The Harborough Publishing Company, Ltd., London, 1944; 31 pages, 1s.

The increase in the interest of youth in model making has led to the building of larger sizes that are replicas of practically every known type of airplane.

Photographs of these models look exactly like their prototypes. This class of model making has apparently been more actively sponsored in England than in the United States. This pamphlet initiates the reader into the phases of this interesting avocation

Slacks and Callouses, by Constance Bowman and Clara Marie Allen; Longmans, Green & Company, New York, 1944; 176 pages, $2.00.

Two school teachers who decided to spend their summer vacation working at the Consolidated Vultee aircraft factory in San Diego have written their experiences with delightful humor. They see the work and the workmen through tolerant eyes and give an amusing account of what a woman encounters when she becomes a cog in a factory's machine.

One of the authors writes and the other draws; their combined efforts have produced a book that will give pleasure to those who are looking in from the outside, as well as those who have the reversed view. They tell of the woes of the personnel routine and then of the problems that their inexperience in factory work brought to them and their fellow workers.

No one will read the book without knowing the many difficulties that have to be overcome by women in aircraft work. But when the reader has finished the book he or she will see that, with a sense of humor, many of the hardships can be overcome without too great a strain on dispositions.

Saturday Flight, by Ethel Wright and Richard Rose; William R. Scott, Inc., New York, 1944; 20 pages, $1.00.

For those who want a gift book about aviation for young children, this small loose-leaf booklet will give instruction and pleasure. The colored drawings are informative and simplified. Such books should be welcomed as a part of the early training of children for life in the age of air transport.

Target Island, by John Brophy; Harper & Brothers, New York, 1944; 184 pages, $2.00.

The conditions in Malta during the period the island was under continuous air attack by the Germans and Italians are vividly dramatized in this novel. A native girl, an English war worker, and three R.A.F. pilots become involved in romantic attachments, which a priest tries to keep within bounds. Two of the pilots are killed and the third recovers from a crash to carry the romance to a happy conclusion.

The author weaves a pattern for his story that holds the reader's interest and gives an intimate view of the emotional as well as the religious temper of the people on the English "immovable aircraft carrier" in the Mediterranean.

Red Randall Over Tokyo, by R. Sidney Bowen; Grosset & Dunlap, New York, 1944; 208 pages, $0.60.

Another of Red's thrilling experiences takes him to Japan on a secret mission. He and his companions complete a flight from Australia to China, where they are taken prisoners. They are rescued and make a sensational flight over Tokyo, which is blazing from attacks by our bombers.

It is a book for boys, written to hold their interest and cause them to envy the daring trio of pilots

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AVIATION GASOLINE

Invasion Journal, by Richard L. Tobin; E. P. Dutton & Company, Inc., New York, 1944; 223 pages, $2.00.

The correspondent for a New York newspaper kept a diary during the bombing of England and while the invasion was in progress. He gives his impressions of London and its people when they were living under exhausting conditions.

He then follows the troops to France and describes the landing and occupation. The very discontinuity of the style of the book adds to its interest.

Warhawk Patrol, by Rutherford Montgomery; David McKay Company, Philadelphia, 1944; 246 pages, $2.00.

Two typical old-time pilots have all the thrilling North African experiences that can be crowded into the chapters of a book. They fly P-40's and get into trouble in camp and tight battle situations in the air. They are captured, betrayed by a spy, escape, and finally became heroes by capturing their traitor.

From beginning to end the story is full of the kind of talk and action that has a great appeal to the youth of today.

The Aviation Dictionary for Boys and Girls, edited by Leslie E. Neville; Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1944; 192 pages, $2.00.

The need for a special dictionary for the young generation is obvious, and this book will meet that need. The definitions are written in clear and understandable language and the illustrations supplement the text by conveying a simplified visualization of the definition. Many of the pictures are printed in two colors to accentuate the part defined.

In addition to the definitions, there are silhouettes of leading American combat and transport airplanes, a map supplement, and a chronology. The latter might be criticized for some of its assertions, as well as its omission of important early American aeronautical events.

The Forgotten Battlefield, by Kazimierz Wierzynski; Roy Publishers, New York, 1944; 179 pages, $2.50.

The fall of Poland was one of the first tragic events of the war. This account of the heroic stand of the Polish army includes a chapter on the desperate defense made by the Falcon Squadron as the story is related by an unnamed lieutenant who participated in the fighting. It is an epic of hopeless fighting against the superior air forces of the Germans.

Weather Predetermined by Solar Variation, by C. G. Abbot; The Smithsonian Institution, Washington, D.C., 1944; 44 pages.

In this pamphlet the writer of two papers titled "The Dependence of Terrestrial Temperatures on the Variations of the Sun's Radiation" and "Further Evidence on the Dependence of Terrestrial Temperatures on the Variations of Solar Radiation" presents new and more extensive proofs of the same thesis.

Aircraft Mechanic's Pocket Book, by John T. Henshaw; Sir Isaac Pitman & Sons, Ltd., London, 1944; 64 pages, 2*s.* 6*d.*

A practical pocket manual containing instructions and data for ground engineers, aircraft mechanics, and inspectors. Information is given about the details of air-frame construction, workshop processes, and the repair of damaged air frames.

Forestry Terminology, compiled and edited by Committee on Forestry Terminology; Society of American Foresters, Washington, D.C., 1944; 84 pages, $2.00.

A glossary of the technical terms used in forestry. It contains terms used in a special sense by foresters, as well as terms from other sciences and industries, the meaning of which a forester should know.

1944 Industrial Management Symposium; Consolidated Reporting Company, New York, 1944; 174 pages.

Twenty-nine addresses and articles by various government and business executives have been compiled in this volume. The articles and addresses refer to the various phases of industrial management and related subjects.

A Source List of Selected Labor Statistics, compiled by a Committee of the Social Science Group; Special Libraries Association, New York, 1944; 37 pages, $1.00.

This booklet contains a compilation of selected publications of government departments referring to labor statistics. Information has been included about prices, unemployment insurance, and the activities of the U.S. Employment Service, because of their bearing on the labor market. Tables that are customarily published together and bear on the same closely related subject have been treated as a group rather than separately. An effort has been made by the compilers to include information currently available, and defense releases have been listed wherever possible. The arrangement is classified under the headings of the various Federal agencies, State agencies, and nongovernmental agencies. The subject and title indexes facilitate the use of the book, and a list is given of the addresses of the agencies and periodicals referred to.

Aircraft Sheet Metal Blueprint Reading, by Harry H. Coxen, Gerald E. Jackson, and Gilbert D. Masters; American Technical Society, Chicago, 1944; 141 pages.

A workbook incorporating a special method of teaching aviation blueprint reading, which the authors have found to be sound and speedy. With this plan the aim is not to teach how to draw, but to teach the student how to understand a blueprint and to explain to him what it shows and how it shows it. This method is based on the theory that a blueprint or a drawing is a means of conveying, from the designer to the workman who is to make or assemble the object, definite ideas concerning the construction or assembly of the object represented on the blueprint. The book explains in nontechnical language how this exchange of ideas is accomplished by means of lines, notes, abbreviations, and symbols. Included are a glossary of aviation terms, abbreviations, tables of specific information, and a brief review of mathematical problems with which an aircraft sheet-metal worker must be familiar.

Navigation Wrinkles for Combat Motor Boats, by George W. Rappleyea; Higgins Industries, Inc., New Orleans, 1944; 121 pages, $1.00.

Special techniques for the navigation of combat motor boats are given in this book. The methods are particularly adapted to the operation of combat boats of the Army, Navy, and Coast Guard.

The Technique of the Terrain, by H. A. Musham; Reinhold Publishing Corporation, New York, 1944; 228 pages, $3.85.

A text on maps and their uses in field operations in war and peace. One chapter is devoted to aerial photography. Among the subjects dealt with in other chapters are the geometry of the map, the construction of maps, drafting, conventional signs, scales, tactical photography, maps and logistics, and military geography.

Weather Codes and Data for Pre-Flight Aeronautics Students, prepared with the cooperation of the Civil Aeronautics Administration; The Macmillan Company, New York, 1943; 57 pages, $0.16.

This pamphlet contains four maps, the analyses of these maps, and the 1942 Weather Code and Code Tables. It has been prepared to assist in the study of meteorology as a part of the preflight aeronautics courses in high schools and colleges.

Centrifugal Pumps and Blowers, by Austin H. Church; John Wiley & Sons, Inc., New York; 1944; 308 pages, $4.50.

A book on centrifugal pumps and blowers written to meet the needs of young graduate engineers who must deal with such equipment. The book covers the basic principles of design, construction, and application along the conventional lines of present-day practice.

Minutes of the Aviation Industry Forum on Air Commerce Problems; under the auspices of the Aviation Section of the New York Board of Trade; New York Board of Trade, New York, 1944; 33 pages, $1.00.

This compilation contains a report of the proceedings of a conference comprising a luncheon forum and exhibit referring to the problems of packaging for air cargo held in New York on June 23, 1944. Various addresses, as well as the discussion that took place, are reproduced in full.

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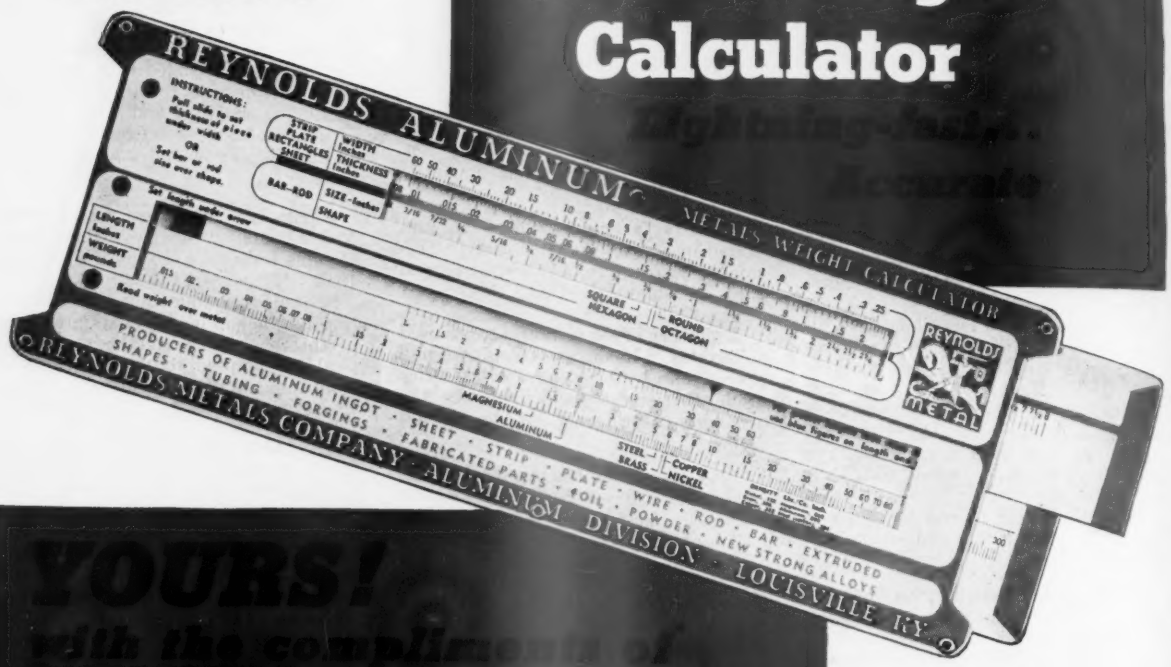

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Conversion Factors and Tables, by, O. T. Zimmerman and Irvin Lavine, Industrial Research Service, Dover, N.H., 1944; 262 pages, $2.75.

This book was prepared as a time-saver for engineers and scientific and technical workers. It is designed to provide in one convenient volume an accurate source of fundamental physical relationships, as well as several thousand useful constants for the conversion of units. Included in the volume are abbreviations, definitions, fundamental values, prefixes, conversion factors, and 14 conversion tables.

The Raft Book, by Harold Gatty; George Grady Press, New York, 1944; 63 pages, $2.00.

A waterproof edition of this book of instructions for emergency navigation has been prepared for inclusion in the equipment of life rafts. The text and illustrations are contained in a staple-bound waterproof paper booklet, and the world chart and navigation tables are printed on opposite sides of a large sheet that is folded into the most compact form and packed in a waterproof envelope. A measuring tape for use with the chart is also packed in the envelope. The book in its original form was reviewed in the September, 1943, issue of the AERONAUTICAL ENGINEERING REVIEW.

Atmosphaerische Turbulenz (Atmospheric Turbulence), by Heinz Lettau; Akademische Verlagsgesellschaft M.-B.H., Leipzig, 1939; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 283 pages, $5.75.

The author bases this book on a dynamic theory referring to the division of the vector of the air flow into intermediate and supplementary motions. Turbulence is understood to be attributable to the existence and the effect of the supplementary motions. This includes the effect of the exchange of air masses. A large part of the book is devoted to considerations of hydrodynamic boundary layers, because all meteorologic observations on the ground are made in turbulent atmospheric boundary layers. The relations between problems of atmospheric turbulence and those of general meteorology are discussed, with special consideration of dynamic relations. For didactic reasons the treatment of laminar flow has been placed ahead of that of the more complicated turbulent flow. The author believes that if the kinetic mechanism of the molecular viscosity in a gas is clearly understood it will be easier for the reader to comprehend the nature of the coefficient of turbulent exchange.

Vier Abhandlungen zur Hydrodynamik und Aerodynamik (Four Treatises on Hydrodynamics and Aerodynamics), by L. Prandtl and A. Betz; Selbstverlag des Kaiser Wilhelm—Instituts fuer Stroemungsforschung, Goettingen, 1927; photo-lithoprint reproduction by Edwards Brothers, Inc., Ann Arbor, Mich., 1943; 100 pages.

Because the publications in which these four technical discussions of certain fundamental theories of hydrodynamics and aerodynamics originally appeared have been out of print for several years, the authors arranged to assemble them in book form. The book has been reproduced in America in order to make the treatises available to many specialists in this country. The contents are as follows: Ueber Fluessigkeitsbewegung bei sehr kleiner Reibung (Fluid Motion at Very Slight Friction) by L. Prandtl; Tragfluegeltheorie, I. Mitteilung (Wing Theory, Part I) by L. Prandtl; Tragfluegeltheorie, II. Mitteilung (Wing Theory, Part II) by L. Prandtl; Schraubenpropeller mit geringstem Energieverlust (Propeller with Smallest Loss of Energy) by A. Betz.

Kurzgefasstes Handbuch aller Legierungen (Concise Handbook of All Alloys), by Ernst Jaenecke; Otto Spamer Verlag, Leipzig, 1937; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1943; 493 pages, $13.15.

This book presents a systematic arrangement of binary and, especially, of ternary alloys. This arrangement makes it possible to add results of new researches, so that analogous material is placed side by side, an accomplishment not reached by other classifications, such as those according to metals or to the alphabet. The author deals with the subject of alloys as briefly as possible without neglecting important facts. For this reason solidification diagrams for all systems are included, from which the experienced metallurgist, without much effort, may solve his materials problem by observing the characteristics of the alloy in question.

The six principal sections of the book are as follows: binary alloys; ternary alloys; ternary iron alloys; quaternary alloys; and alloys of five or more metals.

Elektrische Messgeraete und Messeinrichtungen (Electric Measuring Instruments and Measuring Equipment), by Albert Palm; Springer-Verlag, Berlin, 1942; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 251 pages, $5.50.

This is a textbook requiring a knowledge on the part of the reader of the principles of electrotechnics. Its purpose is to present to engineers and technicians the characteristics of electric measuring instruments and measuring equipment, and the work to which they can be applied. Wiring diagrams, especially those for measuring equipment, are shown in simplified form.

Handbuch der Wekstoffpruefung (Handbook of Material Testing), by Erich Siebel; Verlag von Julius Springer, Berlin; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1943, 1944; Vol. I: Testing and Measuring Equipment, 658 pages, 1940, $23; Vol. II: Metallic Material Testing, 744 pages, 1939, $24; Vol. III: Non-Metallic Building-Material Testing, 800 pages, 1941, $24.10.

The main purpose of this work is to give information concerning all questions of material testing. Research work is referred to only if it has any bearing on the development of the equipment and testing methods. The methods and equipment used are fully described. The contents of Vol. I are as follows: Testing machine for static load: Investigation of testing machines for static load, and checking instruments; Testing machines and equipment for impact stresses; Testing machines for vibration stresses; Special equipment; Methods and equipment for expansion measurement; Application of photo-elasticity; Methods and equipment for stress measurement by means of X-rays; Material testing by means of X-rays and gamma rays.

Vol. II contains the following: Static strength test; Impact strength test; Vibration strength test; Strength at high and low temperatures; Hardness test; Technological tests; Various other tests; Physical Tests; Metallographic test; Principles of the chemical analysis of metals and their alloys; Spectrum analysis; Theoretical strength investigation.

Vol. III is devoted to tests of the following materials: building timber; natural building stones; baked materials; cement, cement mortar, and concrete; trass, brick dust, and granulated blast furnace slag; blast furnace slag to be used as building material; plaster and plaster mortar; magnesia mortar; glass; paints; paper and pasteboard as building materials; glues; tar and asphalt.

Grundlagen der Metallkunde (Principles of Metallurgy), by Georg Masing; Verlag von Julius Springer, Berlin, 1940; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 127 pages, $3.25.

Intended for beginners as well as for those who are interested in elementary metallurgy, this book differs from other textbooks on this subject in that it is intentionally limited to the most fundamental facts. The author aims to present them in the clearest possible manner without going into lengthy details. However, technical problems are mentioned frequently where necessary to give an understanding of the subject.

The first chapter gives a general survey of metallurgy, and the next three sections refer to different aspects of the theory of the structure of alloys. Examples of phenomena in the solid state are discussed in another chapter, followed by information about plastic deformation, inherent stresses, recrystallization, and the chemical reaction of metals against nonmetallic corrosives.

(*Continued on page 191*)

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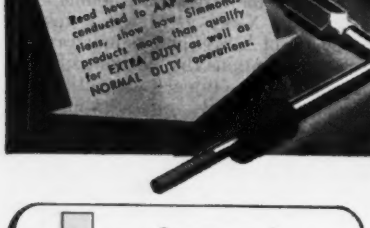

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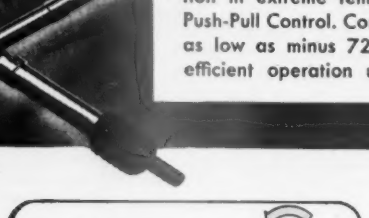

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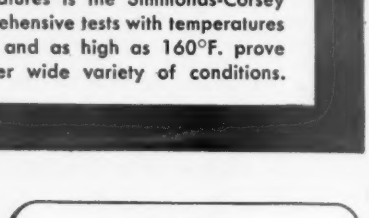

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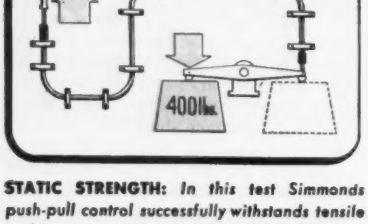

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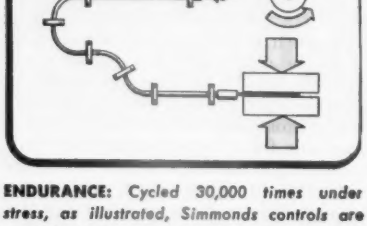

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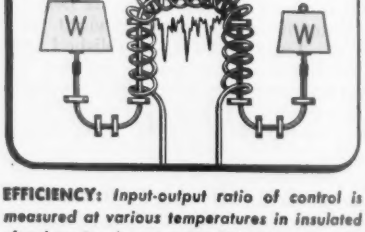

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Aerial maps are reproduced and their making is explained. The concluding pages of the book contain examples of aerial photography in peacetime and examples of the apparatus used in this work. *Fairchild Camera and Instrument Corporation.*

25 Years of Engine Development

The Engineers—The Planners. Telling of the aircraft-engine developments that they helped to accomplish, the author reviews the corporate work of Wright Aeronautical engineers during the past 25 years. The successful results achieved by the application of their collective experience and skill to the following problems are discussed: radial-engine development, altitude performance, good cooling, adequate structural strength, reduction of vibration, use of steel crankcases, and use of forged heads.

The major accomplishments of Wright Aeronautical engineers are reported to include an advance in engine ratings from 150 to over 2,200 hp., a reduction in weight from 3 to 0.97 lbs. per hp., a stretch from 100 to over 1,000 hours between engine overhauls, a gain from a stipulated power at a few thousand feet to cruising power above 40,000 ft., and other advances. *Trade Winds,* October 9, 1944.

Air-Line Expansion

The Airline and Your Community. This 78-page booklet describes a pattern of domestic air-line development intended to provide communities on, or adjacent to, present routes with the economic benefits of transcontinental air-line service. It is stated that the proposed pattern of expansion would render the highest possible standard of transcontinental service. The major portion of the booklet is devoted to a detailed discussion of service for states and communities. *Transcontinental & Western Air, Inc.*

Catalogue of Aircraft Products

Goodyear Aviation Products, Volume 2, contains information and data about fuel and oil cells, hose, packing and seals, engine products, and other accessories. Products developed and produced for specific applications, together with those built to standard specifications that can be readily adapted to different airplane designs, are described and illustrated. The booklet contains 75 pages. *The Goodyear Tire and Rubber Company, Inc.*

Industrial Research

Research in Action is a booklet describing the activities of an institute founded to conduct research for industry on a nonprofit basis. It is noted that operations were started in 1929 and the staff, originally 30, now numbers 600.

The booklet contains a nontechnical account of the major activities, statistics, names of sponsors, and illustrations of the staff, plant, and equipment. *Battelle Memorial Institute,* Columbus, Ohio.

Data on Clamps and Fittings

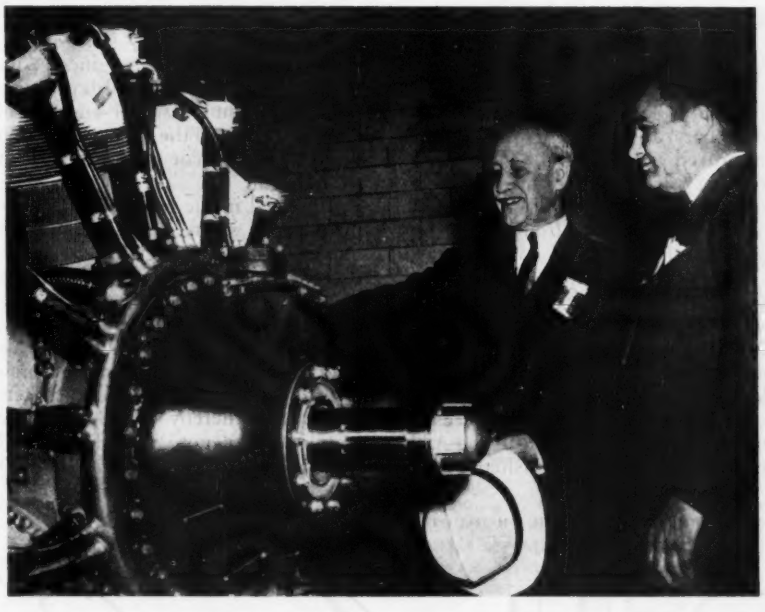
Punch-Lok Streamlined Clamps and Fittings is the title of a catalogue that contains technical data on such devices. The operation of the locking tool for applying the clamps is described. Tables give the specifications of open-end clamps, clamps for welding cable and other electrical uses, and fittings for grooved hose. *Punch-Lok Company,* Chicago.

Cowl Fasteners

An 8-page booklet presents the structural features and specifications of quick-acting fasteners for such purposes as holding cowling and access panels securely in place. An exploded view of the fastener shows the stud assembly, grommet, removable panel, permanent structure, and receptacle. *Camloc Fastener Corporation,* New York.

Cable Swagers

Catalog Section CS supplies information and data about cable swagers. The procedure for setting up and operating these machines is outlined, and

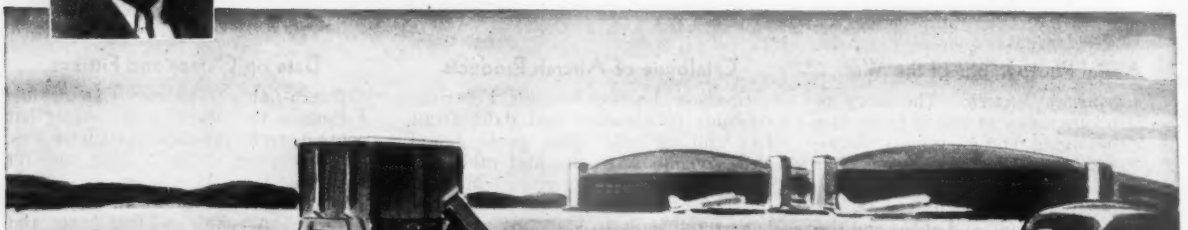


In contrast to Wright Aeronautical Corporation's current observance of its 25th Anniversary and a quarter-century of progress in aviation engine building, this photo, taken in 1941 at the dedication of the company's new Cincinnati, Ohio, plant, shows (*left*) Orville Wright, first man to fly a powered heavier-than-air machine, and G. W. Vaughan, President of Wright, inspecting a 1,700-hp. Wright Cyclone warplane engine dwarfed today by mighty giants of the 2,200-hp. type powering the Boeing B-29 Superfortress. Both men were highly instrumental in the formation, achievement, and success of the Wright company.

DESIGN FOR SAFER LANDINGS

BY FRANK A. TICHENOR

Publisher of Aero Digest explains the action of the Bell-designed shimmy damper now in use on many U. S. planes employing tricycle landing gear



Testing the Bell Aircraft shimmy damper

"THE tricycle landing gear provides definite advantages—elimination of ground looping, and nose-over hazard, superior ground vision, improved ground handling and maintenance, simplified landing and take-off procedure, increased pilot safety, and easy operation from small, improvised fields.

"However, when first developed, the tendency of the nose wheel to shimmy or caster hampered its use by setting up a vibration so great that there were cases in which the nose wheel strut was literally ripped out of the fuselage.

"A former Bell Aircraft sales executive—now a Lt. Colonel in the AAF who wears the Distinguished Flying Cross—and two Bell engineers, ingeniously helped to solve this problem with the shimmy damper—a control which helps keep the nose wheel from rotating more than 60° to the left or to the right.

"Located in the bottom end of the nose wheel strut, it consists of two fixed vanes and a wing shaft on which there are two vanes. This assembly is filled with fluid.

"When the nose wheel tends to turn, the pressure of the wings forces this fluid through a metering orifice which in turn is further controlled by a thermal valve—thereby dampening the motion of the nose wheel's lateral reaction. The only outlet for the fluid is through the valve, which can be adjusted to stiffen or ease up the nose wheel action in accordance with the pilot's requirements.

"The wing shaft can rotate only in a radius of 120°, because of stops which prevent further rotation.

"War planes now land and take off in jungles and from icy steppes as smoothly as at any of our modern airports at home, thanks to this kind of pioneering.

"The shimmy damper is one of the many contributions which Bell Aircraft has made to the progress of the aircraft industry."

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MEMBER AIRCRAFT WAR PRODUCTION COUNCIL...EAST COAST, INC.

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

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Marietta, Ga.
B-29 Boeing Superfortress

the steps necessary to convert a regular cable swager into an automatic die-opening and feeding machine are described. The capacities of cable-swaging machines are listed. *Standard Machinery Company*, Providence, R.I.

Carbide-Tipped Tools

Metro Standard Carbide Tools is a 6-page illustrated bulletin describing a line of carbide-tipped tools for turning, facing, and boring operations on all types of steel, cast iron, bronze, aluminum, and nonmetallic materials. The specifications of the tools are listed. *Metro Tool & Gage Company*, Chicago.

Progress in Engine-Manufacturing Procedures

The Workers and their Tools. The evolution in methods of manufacturing Wright Aeronautical engines is traced from the years following the first World War until the present time. Machining, foundry, and assembly procedures used by the company in its early years are compared with those currently employed. *Trade Winds*, October 9, 1944.

Thermocouple Data Book

Wheelco Thermocouple Data Book and Catalog is a new edition, designated as *Bulletin S2-5*, contains 40 pages. The catalogue describes the products and offers recommendations for thermocouple users. It gives data helpful in selection of thermocouples, lead wire, protecting tubes, heads, and insulators. Also included are millivolt tables on the various types of thermocouples, temperature-conversion tables, tables on wire resistance and pipe and wire sizes, and a fractional-decimal equivalent chart. *Wheelco Instruments Company*, Chicago.

Testing Machines

Riehle Testing Machines. Hydraulic precision testing machines and instruments are described in an 8-page folder. Information is given about machines for testing impact, tension, compression, and hardness. *American Machine and Metals, Inc.*, East Moline, Ill.

Propeller Maintenance

Wood Propellers. This booklet offers suggestions for the care and maintenance of wood propellers. Operating precautions are given, and a section on inspection tells how to determine when the propeller needs attention. Notes on propeller installation are provided and common propeller terms are defined. *U. S. Propellers, Inc.*, Glendora, Calif.

Carbide Tooling

Carbide . . . The Industrial "Cut-up." Some notes are given on the advantages of using carbide-tipped tools for machining operations. A comparison is made between two gear-machining operations—one employing a carbide tool; the other, a high-speed steel cutter. The surface feet per minute for each operation, the overall machining time per piece, the regrinding frequency, and the surface finish of the machined part are contrasted, to the advantage of the carbide tool. *The Bellringer*, October, 1944.

Airport Planning

Take-Off Now with Your Aviation Plans is the title of a booklet on airport planning. Nine benefits that a community can derive from an adequate airport are listed, as well as 23 factors that must be considered in planning an airport. *The Baker Engineers*, Rochester, Pa.

Electronics in Industry

Industrial Electronics is the title of a 96-page publication describing some of the many existing applications of electronic equipment. More than 150 individual uses of electronics are described. Some of the subjects discussed include resistance welding control; electronic heating; temperature control; inspecting, testing, and counting; measurement; positioning control; electronic timing, and X-rays in industry. *General Electric Company.*

Piston-Ring Lapper

Machine Seats Rings. A short article describes the piston-ring lapper devised by maintenance personnel of Mid-Continent Airlines. Replacing a manual operation, this device is used for seating piston rings. It is reported to result in a saving of three man-hours during every engine overhaul. The lapper works as follows: Rings are placed in the piston grooves, a mild abrasive compound is applied, and the piston is then fitted into the cylinder. When the machine is in motion, the piston makes a straight upward stroke and spiraling downward stroke, gradually removing all toolmarks from the rings and providing a perfect "fit" to insure the proper "seal" when the cylinder is first placed in operation as a part of the engine. *Mid-Continent Airlines Wing Tips*, October, 1944.

Data on Ethyl Cellulose

Hercules Ethyl Cellulose. A 48-page booklet describes types and grades of ethyl cellulose, discusses their properties, and contains a blending chart. Information is also given about ethyl cellulose formulations and specific applications of the material as a base in various industries.

A second booklet, of 24 pages, is devoted to ethyl cellulose formulations with resin plasticizers and has been prepared for those interested in making practical use of ethyl cellulose. The data are based on an examination of 42 commercial types of resins. Both books contain numerous tables and charts giving technical information. *Hercules Powder Company, Inc.*, Wilmington, Del.

Aerial Surveying Methods

The Higgins Patented Aerial Survey Camera and Method describes 16 different ways in which the camera and method can be helpful to engineers. It is explained that this aerial photographic method was developed and perfected to provide an economical means of obtaining engineering data and operational charts to make transportation feasible in remote sections of the world. *Higgins Industries, Inc.*, New Orleans.

Relays and Solenoids

Relays by Guardian. A 4-page illustrated bulletin gives the details and operating characteristics of eight relays and eight solenoids. Relay charts show standard voltages, maximum contact capacity, coil resistance, and operating current. Solenoid charts give resistance and operating current at standard voltages and show the stroke and lifting capacity of small solenoids. *Guardian Electric Manufacturing Company*, Chicago.

Labor Relations

We Led With Our Chin is the title of a booklet containing an analysis of an employee survey conducted in the plants of a manufacturer. A second booklet, titled *Humanizing Labor Relations*, contains a summary of the conclusions reached from the analysis. *Thompson Products, Inc.*, and *Thompson Aircraft Products Company*, Cleveland.

Wire Grommet V-Belts

A 4-page folder on wire grommet V-belts explains and illustrates the construction of the belt and describes various types of belts for power-transmission applications. *The B. F. Goodrich Company.*

Radio Masts and Towers

Harco Masts—Towers. A catalogue describes a line of steel masts and towers for radio communication, airport lighting, and radar. It contains specifications, constructional details, and illustrations of the various types of masts and towers, including those having unusual features of design. *Harco Steel Construction Company, Inc.*, Elizabeth, N. J.

Book of Cartoons

Willie Wingflap cartoons by Dennis McCarthy, which originated in *Skywriter*, the employee newspaper of the California division of North American Aviation, Inc., have been assembled in a ring-bound book. The pictures show the amusing little character in all sorts of humorous antics in and around an aircraft plant. In addition to providing diversion for employees, the cartoons have been used for the promotion of the sale of War Bonds and in the Red Cross and War Chest campaigns. The book is reported to contain a complete record of the Wingflap cartoons up to the date of publication. *North American Aviation, Inc.*

Air-Power History

History's Lesson to Air Power. P. W. Litchfield. The evolution of transportation is traced, showing that advances

in world leadership have been made by those nations that first made the best use of transport routes. The function of air transport is emphasized, and it is stated that America must emerge from the present war as the dominant air power of the world and must maintain that dominance. The important contribution of air transport to peacetime commerce also is emphasized. *Goodyear Tire & Rubber Company, Inc.*

Welding-Control Equipment

Seam-Welder Controls for Resistance-Welding Machines gives information about apparatus and methods used in seam-welding processes with particular reference to the control equipment. The advantages of electronic seam-welder controls are outlined, together with the features of this manufacturer's electronic controls for seam welding. The text matter is supplemented by oscillograms, tables, and photographs. *General Electric Company.*

Miniature Precision Bearings

Bulletin No. 44 describes a group of miniature ball bearings for industrial, commercial, and special uses. It contains specifications for radial-type and pivot-type ball bearings, with data concerning the materials, load ratings, tolerances, and the speeds, hardness, and other properties of the bearings. Information is given also about the applications for which these miniature bearings are designed. *Miniature Precision Bearings*, Keene, N.H.

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Can be set in 4 seconds and released instantly. Ratchet set with side screw powerful fulcrum leverage tightening. 1-hand operation with absolutely non-creeping grip even on irregular surfaces. Setting the pace in war production everywhere.

Ask also about our complete line of Alloy-Steel "C" Clamps with *even greater than* forged clamp capacities, but cost less. Opening sizes up to 18" and proof test capacities up to 19,000 lbs.

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Instrument-Catalogue Sections

New sections have been issued for various loose-leaf catalogues relating to Pioneer instruments as follows: *43-1 Overhaul Manual* for electric tachometer indicators; *44-21A Installation and Line Maintenance Bulletin* for the autosyn-tachometer transmitter; *45-31 Service Bulletin* for the installation of new glands in demand oxygen regulators.

The following manuals referring to tools and fixtures also are now in effect: *46-2*, for servicing magnesyn remote-reading compasses; *46-2A*, for servicing air-speed indicators; *46-14D*, for servicing altimeters; and *46-16C*, for servicing 400-cycle inverters. *Eclipse-Pioneer Division of Bendix Aviation Corporation.*

Cutting Tools Bulletin

Clark Adjustable Cutters, Catalogue No. 44 contains specifications and detailed descriptions of the entire group of Clark adjustable cutting tools. The principles of adjustability are explained and the numerous types of tool holders are shown. Tables give detailed specifications and data for the application of the tools in industrial operations. A pictorial index is provided by which descriptions of the different types of tools can be readily found in the catalogue. *Robert H. Clark Company*, Beverly Hills, Calif.

Wing-Lift Method

Lifting 20 Tons of Wings. A production technique employed by Bell Aircraft Corporation for lifting entire wing sections for the B-29 is described. The maximum load for which the wing-lifting cranes are designed is 10 tons, which is equal to about half the weight of the entire wing section. Therefore, it had been necessary to lift half a wing section at a time and move it to the next station, requiring two trips to move an entire wing section. By the new method the weight of the entire wing section is applied on each of two separate trusses in the same aisle. This eliminates the possibility of imposing twice the crane load on the same side of the centerline on a single truss at the same time and enables the entire wing section to be moved in one operation instead of the two formerly required. *The Bellringer*, October, 1944.

Milled Sponge Rubber

A catalogue section has been issued on milled sponge rubber for sealing, cushioning, and absorbing vibration. The section describes sponge made from either synthetic or reclaimed rubber and lists sizes, weights, and other pertinent data in tables. *The B. F. Goodrich Company.*

Making Aircraft Tubing

Plant Makes Alloy Tubes for Airplanes and Other Vital War Products. This article describes the equipment and methods used in the production of seamless alloy-steel tubing for various aircraft parts, as well as other uses, in a plant of the National Tube Company, a subsidiary of United States Steel Corporation. It tells how existing plant equipment was adapted for the production of these specialized products, emphasizing the speed with which the equipment was put into operation when the demand became urgent. It is noted that approximately 36 per cent of the plant's output is used for aircraft and another 36 per cent for Army Ordnance items. The two main processes by which the hot-finished products and cold-finished products are made are described from the delivery of the steel billets to the shipment of the finished products. Sketches show the method of rolling seamless tubing and the cold-drawing process. Photographs show some of the machinery in operation. *U. S. Steel News*, October, 1944.

List of Technical Memorandums

Subject Index of the National Advisory Committee for Aeronautics is a compilation of the *N.A.C.A. Technical Memorandums Nos. 1 to 1,062*, inclusive. The subjects are classified alphabetically, and under each classification memorandums are listed alphabetically according to the name of the writer, followed by the title, memorandum number, and date of publication. The current edition was revised to July, 1944. *Chrysler Engineering Library, Chrysler Corporation.*

Air-Transport Statistics

Little Known Facts About the Scheduled Air Transport Industry, of which the sixth edition was published in September, 1944, contains some information that had been withheld for military reasons for the first two years of the war. It also gives the facts and figures concerning the operations of the air-transport industry with graphs and charts. *Air Transport Association of America.*

Making Ammunition Chutes

Chuting for the A.A.F. The design and production of ammunition chutes for aircraft machine guns, as carried out by the Lewis-Larson Company of Los Angeles and others, are described. The requirements for making these flexible ammunition chutes, which carry shells to the machine guns, are outlined briefly, as well as the manner in which the design problems were solved. The production processes are explained and installations of the finished chutes in military aircraft are described. *Steel Horizons*, Vol. 6, No. 4.

Postwar Air Routes

Postwar World Airways are indicated on a world map. Solid lines on the map show the logical trunk and feeder routes connecting the centers of world trade, these being routes that have been, or are being, flown by civilian or military transport planes. By means of dotted lines certain prospective trans-polar

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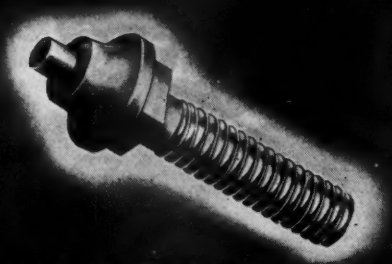

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Early clarification of your plans for fastenings can well be the difference between a fast and precise assembly job and one involving costly delays. Avoid headaches by planning early—in the products design stage—the fastenings required to meet your specific needs. Your choice—standard or special design—is vital not only to fast assembly, but to "making" your product. No product can be better than its fastenings.

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3 Washer-Screw Assemblies—When use of lock washers is indicated, the time-saving of pre-assemblies is obvious. Also available in standard slotted head styles.

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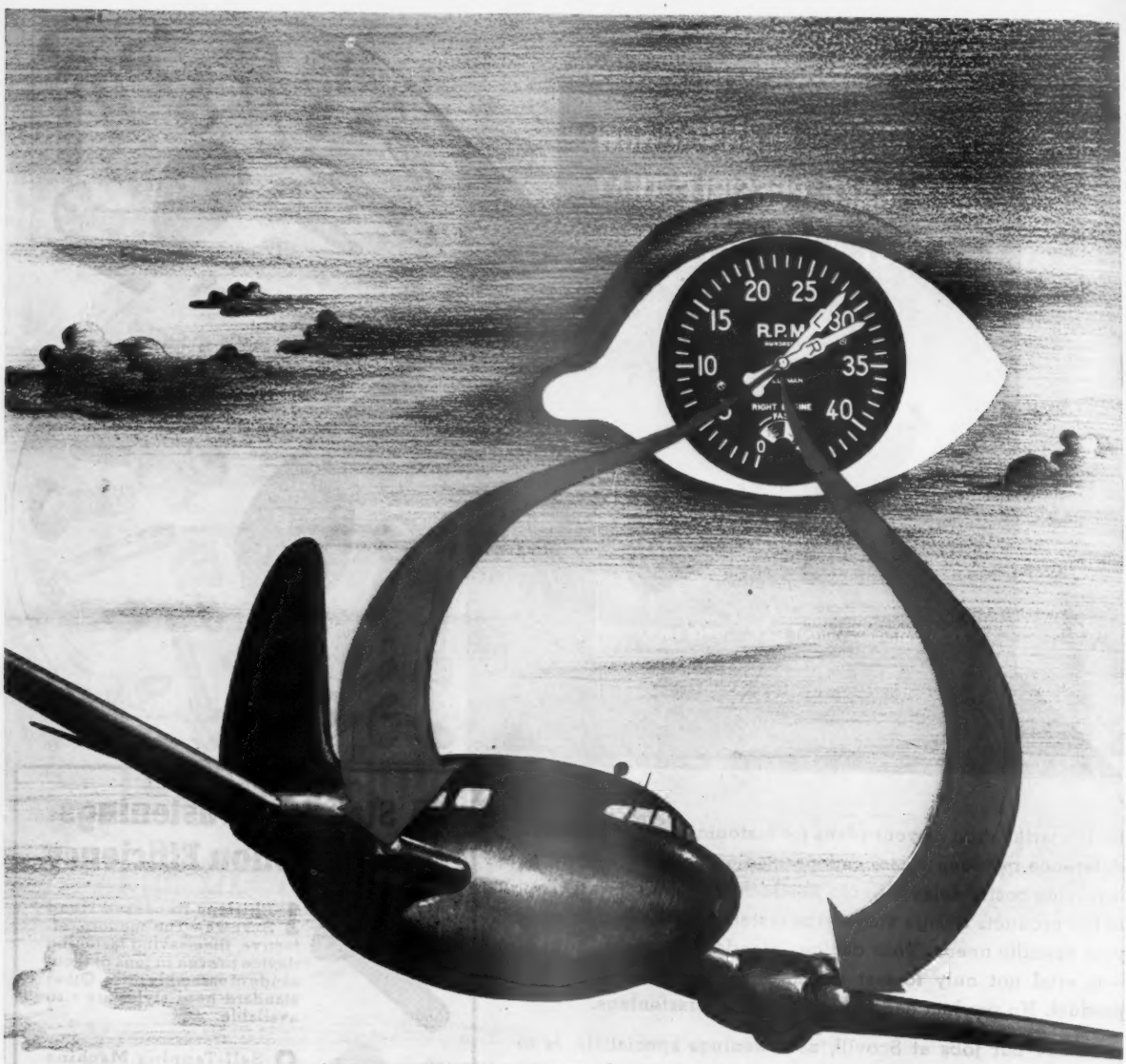

FOR TWIN-ENGINED AIRCRAFT, a new weight-saving, space-saving three-in-one instrument is available in the Kollsman Combination Dual Tachometer and Synchroscope. Indication of the speed of both engines is given on the dial of one instrument. Quick synchronism is obtained by simply matching pointers and then adjusting the throttle until the synchroscope dial is motionless.

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routes are indicated from Chita, in Siberia, to Chicago, and from Moscow to Fairbanks. *Newsweek Magazine*, New York.

Booklet on Shear Resisting Rivets

A 12-page illustrated manual describes the features and advantages of Hi-Shear rivets, a development of North American Aviation, Inc. The application of these shear-resisting rivets by the gun method and the squeezer method is described. Information is given regarding the inspection of the rivets after they are applied. *Pheoll Manufacturing Company*, Chicago.

Production and Maintenance Suggestions

McDonnell Bulletin, September 22, 1944. (1) By means of a shearing die to cut the bevel at the end of long angles or stringers, both a shearing and a sorting and handling operation are eliminated; (2) a block for the lining-up of the tip bow eliminates guesswork, reduces scrap, and saves time in performing the operation; (3) the use of a single toggle clamp for a subassembly operation on a beam results in a saving of time.

North Ameri-Kansan, September 29, 1944. A rivet-spacing tool for the Erco riveting machine enables the machine operator to space properly, locate, and install the rivets without pilot-holes or spotlight.

North American Aviation Take-Off, September 29, 1944. An improvement on the holding jig used in the assembly of air scoops reduces the amount of hand fitting.

Ryan Flying Reporter, September 22, 1944. (1) Set of dies eliminates "oil-can effect" on small skin surfaces or ribs; (2) a jig for holding templates provides easy access to them while they are being filed; (3) a spring catch for holding part of a welding jig eliminates need for extra operator to insert holding pin; (4) adjustable table-type fixture for feeding material to the nibbler eliminates the use of pliers to hold metal parts; (5) a hand-rivet squeezer for riveting or dimpling structures that are either inaccessible or too thin for ordinary riveting methods; (6) a special doping jig makes it possible for both sides of an elevator to be doped by revolving the elevator in the holder; (7) new type Tannewitz band saw brake shoe is made of two parts held together by springs and is not subject to constant breakage; (8) a special attachment for a lever-controlled valve closes both gas lines simultaneously through the function of a single plate which is self-adjusting and overcomes leaking difficulties; (9) by welding the holder to the jig and then bolting the surface table to the holder, warping and subsequent grind of the surface table are eliminated; (10) special spring-type holding clamps for a spar table; (11) a process wherein a one-inch layer of rubber is vulcanized on both sides of the rubber hydropress pad after the pad has been badly worn saves discarding of pad.

North Ameri-Kansan, October 13, 1944. (1) A special tester makes possible the testing of rotors, stators, bearings, and drive shafts of router-machine motors without accompanying assembly and disassembly operations; (2) an improvement on the hoist for setting and changing dies.

Tulsa Douglas Airview News, October 6, 1944. A new type shoe for the monorail overhead crane saves man-hours, material, and money.

North American Skywriter, October 6, 1944. (1) Inserts for master dies; (2) hone adapter for cylinders.

Noorduyn Tale-Spin, October, 1944. (1) Holders for rods during electroplating operation; (2) idea for complete assembly of rout-fitting in the preliminary jig; (3) a jig for better and more accurate installation of parts on the door frame; (4) suggestion for eliminating a safety hazard and effecting a time-saving on punch press work; (5) device for elimination of filing on ribs and collars; (6) simplification of welding jig for the undercarriage leg; (7) brackets for holding spars while working improve quality of spars and eliminate unnecessary operations; (8) clamp for end plate on aileron base allows greater accessibility for operator; (9) new method of working on plate, gusset, and bracket of lever rudder on the front shaft pedal saves time.

North American Aviation, Inc., Take-Off, October 13, 1944. A new hydropress form die, for use on ribs having flanges that are difficult to form, combines a drawing action with a final sizing movement.

Northrop Aircraft, Inc. (1) Rocker-type pin router jig eliminates hand routing of parts with large contours; (2) quick connectors for hydraulic testing-machine lines enables lines to be connected in one-third the time formerly required and reduces wear and tear on both the hydraulic fittings and the testing lines; (3) a punch die, incorporating standard strippet punches and a different method of nesting contoured parts, reduces tooling costs by one-half and cuts maintenance expenses 94 per cent on one operation; (4) landing-gear lever safety clamp prevents accidental changing of the lever's position while the plane is on the ground or about to land; (5) hydropress shrink block eliminates handwork in removing wrinkles from contoured flanges and saves time; (6) an air mixing chamber for the natural-gas torches used in preheating Kirksite dies enables a higher heat to be obtained with less fuel; (7) a new-type clip for stringer locators on subassembly jigs prevents scratching of parts and utilizes scrap rubber; (8) a vise-grip wrench drill jig for use in drilling basket nut holes and Airloc Fastener holes in sheet metal parts provides a jig that holds fast even while drilling stainless steel.

Douglas El Segundo Airview News, October 19, 1944. (1) A suggestion for obtaining angular tolerance on formed pars; (2) a replacement throttle valve for pneumatic squeezers.

Douglas Airview, October, 1944. (1) Installation of 4-microfarad, 50-volt, direct-current filter condensers across wires leading out of aircraft's heater eliminated ignition noise from radio circuit; (2) extension of headers along the rim of the cargo doors where they join the legs of the assembly prevents breakage of material along radius as parts are stamped on hydropress; (3) drilling fixture for locating nut planes in service door of wings not only locates 100 holes but also serves as guide for drilling; (4) attachment of a spring lock to toggle pliers adapts the pliers to various assembly operations and eliminates "C" clamps; (5) indicating angular tolerances of formed parts on all engineering drawings aids shop procedure, reduces unnecessary operations and rework, is better indication of use of flanges, and aids in obtaining accurate bevels; (6) establishment of a monorail-repair base with a power-disconnect area controlled by a switch, for the repair of overhead cranes, permits production to continue while repairs are made; (7) procedure for making tooling blank-out parts from raw stock in one operation on Minster press eliminates hand-forming operation; (8) drill-press accessory jig to hold bushings for burring operations turns out three times the production of the hand method; (9) replacement throttle valve for No. 14 Chicago pneumatic squeezers does not require heat-treatment or close tolerances; (10) use of round head screws in tank-compartment lining eliminates countersinking 578 holes and saves four or five counterbores per plane; (11) overhead hoist using Thor pulley enables one operator using a standard drill and rivet machine to exceed output of two hand workers in assembling antidrag line.

North American Aviation, Inc., Take-Off, October 20, 1944. Gauge for the setting of 0.50-caliber machine guns.

The Kinner Log, October 5, 1944. (1) Adapter to fit the power head of a Hall valve-seat grinder; (2) new tool overcomes loss of baffle plates; (3) clamp-down fastener for cowlings; (4) gauge for measuring intake and exhaust holes on the rocker boxes; (5) a grinder is used in a flexible shaft to grind off burrs on edge of barrel where counterbored; (6) tool for burring damaged buttress threads.

The Northrop News, October 25, 1944. (1) Mill fixture enables the accurate trimming of small tubing prior to welding; (2) rivet jig and check fixture for nose-rib assembly; (3) new method of forming swaged end on 2-in. tubing; (4) wrench for setting propeller blades; (5) new method of connecting a manometer to gas tanks for testing purposes; (6) tensiometers for calibrating spot-weld testing machines; (7) method for fabricating auxiliary spools for electric wiring; (8) propeller-circuit tester.

Aviation Maintenance Engineers

look like this . . .

because

parts made of HYCAR have these . . .

RESISTANCE TO GASOLINE AND OIL

Hycar's resistance to petroleum products means that parts made from Hycar—gaskets, seals, hose, accumulator bags, and others that are exposed to petroleum products—won't swell, won't absorb petroleum and take on extra weight. Dimensional stability is assured. Maintenance and replacement time is practically eliminated.

RESISTANCE TO COLD AND HEAT

Hycar compounds can be made to operate in temperatures as low as —65° F. or as high as 250° F., maintaining elasticity and resilience at the low temperatures, refusing to soften at the high. Parts last longer—little or no maintenance required.

RESISTANCE TO ABRASION

Abrasion resistance is considerably better than natural rubber and most other synthetics. Wear—and hence maintenance—is negligible, even in severe service.

RESISTANCE TO COLD FLOW OR CREEP

Even at elevated temperatures parts made from Hycar have a minimum tendency to cold flow or creep after they take permanent set from the applied loads. Hycar stays on the job—maintenance time goes down.

LIGHT WEIGHT

The specific gravity of crude Hycar is 1.00, 15% to 25% lighter than many other synthetic rubbers. Correspondingly lighter in compounded forms, Hycar parts reduce overall weight, permit more efficient operation.

THESE AND OTHER PROPERTIES OF HYCAR,

such as high tensile strength and good elongation, may be had in a wide variety of combinations to meet specific service conditions. Thus the right part for the right place can be obtained. And when the part is *right,* maintenance becomes a very minor problem. If you need help in solving your individual application problems, just write our Technical Service Staff. *Hycar Chemical Company, Akron 8, Ohio.*

Hycar

Reg. U. S. Pat. Off.

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Synthetic Rubber

Free—write for your copy of the new pocket-size Hycar Glossary of commonly used synthetic rubber terminology.

From the Industry

Adhesive for Wooden Aircraft Structures

Beetle cements were especially developed for use in the production of wooden aircraft such as the Mosquito. These cold-setting urea-resin adhesives are particularly intended for assembly gluing where complex shapes prohibit perfect joining and high pressures are not applicable to ensure uniformly thin glue lines. The cements also have the quality of being able to fill gaps and slight variations occurring in the wood. The glue lines are unaffected by exposure to moisture, heat, or cold.

In gluing wooden composite structures such as the fuselage and wings of the Mosquito, all types of joints are encountered. For scarf joints, joints between positive and negative curved surfaces, and joints between plywood and small wooden stringers, where it is frequently impossible to apply sufficient heat or pressure for a uniformly thin glue line, the Beetle cements are reported to form a strong, indestructible bond.

In the construction of wooden structures, prefabricated arches, beams, trusses, and other structural parts, these same cold-setting, gap-filling properties of the adhesive are expected to give strength, safety, economy, and speed in production. The thick glue line will make possible a tight, permanent bond in the manufacture of wooden truck and bus bodies, boats, and aircraft with complex curved surfaces. American Cyanamid Company, Plastics Division, New York.

Fortresses Adopt German-Designed Latches

B-17's now coming from production lines are equipped with latches, based on a German-designed latch, for numerous access doors on wing sections and engine cowlings. The latch was adapted from one found on a German Messerschmitt fighter plane shot down by Allies in the European theater of war. Previously these access doors on the Flying Fortress were opened by unscrewing two or more screws. The German latch operates by mere pressure of the finger against it. It springs open with this pressure, saving a considerable amount of time.

Engineers are now engaged in refining the workings of the latch to make it still more effective. Boeing Aircraft Company.

New Grommet for All Thicknesses

A new grommet is being manufactured for the Camloc No. 4002 Series fastener. This flush-mounted grommet may be used on all sheet thicknesses. It replaces seven different grommets previously needed to handle the same range. Made of steel, it is permanently secured in the panel. A preformed flange on the outside is designed to give uniform strength characteristics irrespective of the type of installation.

The new grommet requires only a shallow dimple, thereby keeping the sheets from cracking at the edge of the dimpled hole. It does not rotate with the stud assembly, so that the sheet is protected from spalling. Its tapered design and the removable stud assembly that retracts in the grommet permit installation of the fastener on sharply curved sheets. Camloc Fastener Corporation, New York.

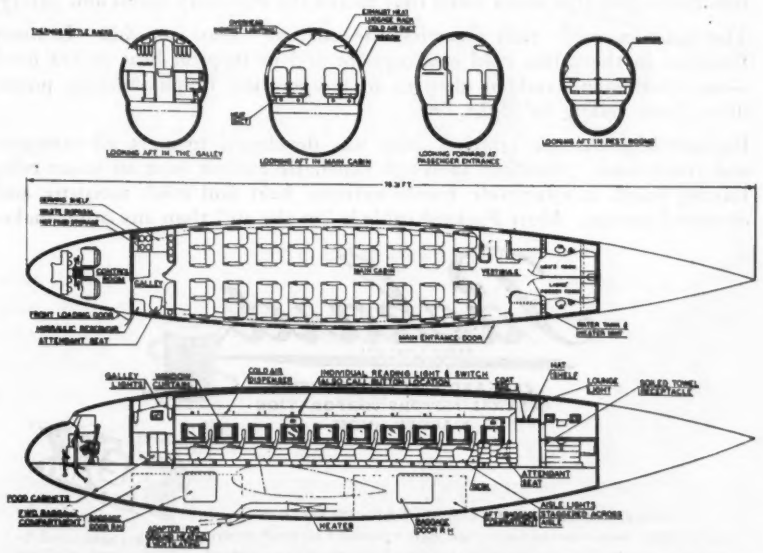
Curtiss CW-20E Commando Transport

The Curtiss CW-20E Commando is a combination passenger and cargo airplane designed to meet the postwar needs of the medium-range air-traffic market. According to a survey by the builder, 85 per cent of the normal business of United States air lines is in the medium range involving trips not exceeding 600 miles. However, the maximum range of the new plane is 1,520 miles and it is designed to take off from and land on the average commercial airport. It is a transport version of the military plane designated by the Army as the C-46 and by the Navy as the R5C, which is serving as a cargo plane in many parts of the world. It is a low-midwing monoplane.

Among the basic design changes resulting from operational experience under a wide range of weather conditions are all-welded, easily removable fuel tanks; redesign of the nose; more powerful engines; improved flight control; greater speed; and increased weight and pay load.

The silhouette is changed by a recessed nose providing greater vision and improved deicing for bad-weather operation. Deep side-view windows increase the pilots' range of vision in landing operations. Improved ground visibility in wet-weather flying is provided. Double-pane safety glass equipped with defogging nozzles gives clear vision in cold flying weather. Recommendations of the Civil Aeronautics Administration for a "bird-proof" windshield have been incorporated.

Ventilating air enters the cabin from a continuous duct at the base of each cabin wall and is discharged through the overhead indirect lighting system.



Various cross sections of the fuselage, the floor plan, and the side view of the new Curtiss CW-20E Commando Transport plane.

PACKARD
HIGH-ALTITUDE IGNITION CABLE No. 530-E

It's not the engine alone, or the propeller biting at thin air, or the slow surge of the wing de-icers . . . it's all the little and big things together that *counts* when the altimeter hovers at the eight-mile mark. Everything must function—give that extra value that means the necessary speed and safety.

The ignition cable that "carries the current" *must not fail.* It must function in the bitter cold stratosphere and in tropical heat at sea level—must withstand sudden changes in temperature in plummeting power dives from ceiling to flight line.

Packard high-altitude ignition cable was developed to meet all extremes and conditions. Sheathed in tough synthetic rubber over an inner reinforcing braid, it effectively resists extreme heat and cold, moisture and electrical corona. More Packard cable is "in the air" than any other make.

Packard
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PACKARD ELECTRIC DIVISION
GENERAL MOTORS CORPORATION
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PACKARD CABLE SERVES THE ARMED FORCES
on trucks • jeeps • tanks • armored cars • planes • aircraft instruments • anti-aircraft gun controls • landing boats • radio equipment.

ARMY E NAVY
A second star has been added for continued excellence

It's Not Yet Time to Break Ranks—KEEP BUYING WAR BONDS

The main ventilating system completely changes the air once every minute. For the traveler who desires additional fresh air, each double seat is equipped with an adjustable air vent that does not affect other passengers. In the overhead panel convenient to each chair is an individual reading light and service button.

The heating installation will maintain an inside temperature of 70°F., although the outside temperature is as low as −40°F.

The pilots' compartment, designed to provide for ease in reaching controls, has seats for two pilots and "jump seat" facilities for a third crew member. All controls are grouped forward so pilots do not have to reach backward for the controls. Cockpit illumination is supplied by a combination of incandescent light and "black light" of controlled intensity to suit existing conditions. A complete installation of radio and electronic directional controls and ground communications is furnished.

Control of the airplane in flight is accomplished through aerodynamic balance and spring tabs on ailerons, rudder, and elevators instead of hydraulic power boost. All control surfaces are of metal construction.

In the two cargo holds there is 526 cu.ft. of space for luggage, mail, express, and other shipments. The two large cargo compartments are in the lower section of the airplane, one forward and one aft, where they are accessible for loading from the ground. These sections can accommodate full-size wardrobe trunks or cases. Lights, controlled from just inside the door openings, illuminate the cargo compartments to facilitate loading and unloading.

The following are brief specifications of the commercial Commando: passenger capacity, 36 to 42; normal take-off gross weight, 48,000 lbs.; manufacturer's weight, empty, 32,100 lbs.; design useful load, 15,900 lbs.; wing area, 1,360 sq.ft.; span, 108 ft.; length, 76.31 ft.; height, 21.7 ft.; engines, two Wright Cyclone C18-B2, 100 hp. each; maximum gross landing weight, 46,400 lbs.; maximum pay load, 12,430 lbs.; propellers, Curtiss electric three-blade, quick-feathering, constant-speed; maximum cruising speed at 10,000 ft., 242 m.p.h. Curtiss-Wright Corporation.

Douglas DC-7 Transport Features

Some details have been made public concerning the Douglas DC-7 transport, 26 of which have been ordered by Pan American World Airways. The new plane will carry 108 passengers and a crew of 13 and will be capable of speeds of more than 300 m.p.h. Pressurized cabins will provide for comfortable travel at an altitude of 20,000 ft.

It is reported that the wings of these new clippers will be longer from tip to tip than the height of a 16-story building. They will be large enough to contain interior passageways for servicing and repairing engines in flight. The plane itself will be twice as large as the Clipper type now flying Pan American's

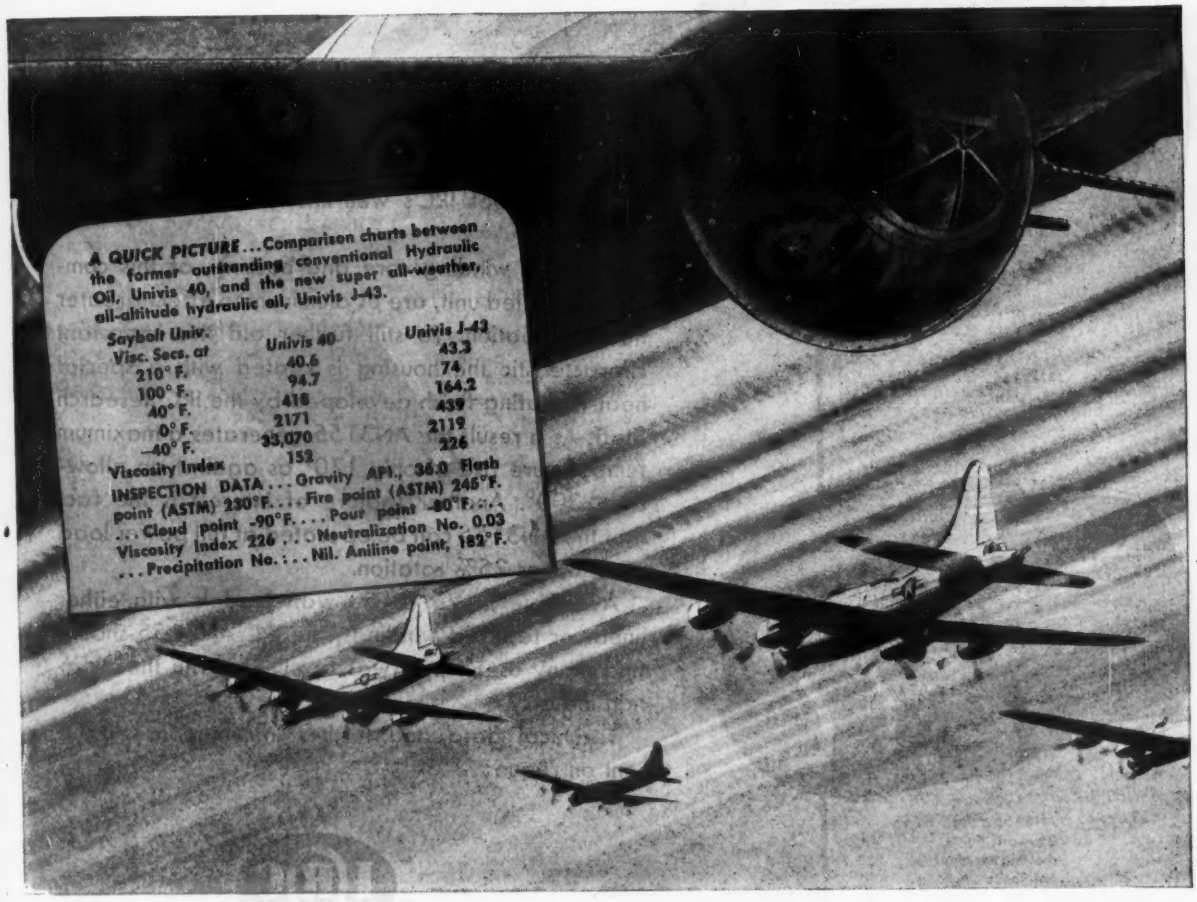
An aircraft hydraulic oil with a 230°F. temperature range...

THE NEED...

one super-hydraulic oil to do the work of two. Its job—to provide satisfactory operation of aircraft hydraulic mechanisms at temperatures varying from below –80° F. to above 150° F.

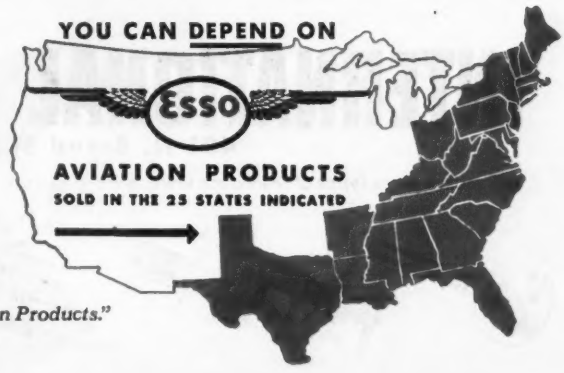
THE PRODUCT ANSWER...

Univis J-43, an Esso Aviation Product, developed in close cooperation with the armed forces. We were the first, and for many months, the only producer and supplier of this miracle hydraulic oil.


A QUICK PICTURE...Comparisen charts between the former outstanding conventional Hydraulic Oil, Univis 40, and the new super all-weather, all-altitude hydraulic oil, Univis J-43.
Saybolt Univ. Visc. Secs. at
Univis 40
Univis J-43
210° F. 40.6 43.3
100° F. 94.7 74
40° F. 418 164.2
0° F. 2171 439
–40° F. 33,070 2119
Viscosity Index 152 226
INSPECTION DATA... Gravity API., 36.0 Flash point (ASTM) 230°F.... Fire point (ASTM) 245°F. ... Cloud point -90°F.... Pour point -80°F.... Viscosity Index 226 ... Neutralization No. 0.03 ... Precipitation No.: ... Nil. Aniline point, 182°F.

WHEN YOU FLY *with Esso Aviation Products, you fly with dependable products. Backed by forty-one years of practical experience, by 1,500 research scientists working in the world's largest petroleum laboratories, we have made it our job to keep not only abreast but ahead of fast-developing aeronautical progress.*

Today one out of every four *U. S. and British combat aircraft fly on 100 octane gasoline from the Esso refineries: and tomorrow, on the airlines of peace and commerce, our promise will remain as staunch as ever—"You can* depend *on Esso Aviation Products."*



MEET IRC'S...

AN3155
POWER RHEOSTAT

AN3155
50-watt

AN3155
25-watt;
showing terminal
positions

Here's a power rheostat with a *short* past but a *long* future. Rugged in construction, light in weight and neat in appearance, it conforms in every respect to Army-Navy AN3155 specifications. It embraces all the features of IRC's well-known PR25 and PR50 rheostats.

Both the winding core and housing, of this completely sealed unit, are of aluminum to effect greater heat dissipation. To still further aid this important characteristic the housing is coated with a special heat-radiating finish developed by the IRC Research Staff. As a result the AN3155 generates a maximum temperature rise of only 170° as against an allowable 300°. Another feature of interest is the fact that the AN3155 can be operated at full power load in as low as 25% rotation.

Available in 25 or 50 watt models with either linear or tapered windings, the IRC AN3155 should find many useful post-war applications in the aviation industry.

Technical data and further information will be sent on request.

PREFERRED FOR PERFORMANCE · IRC · FIXED & VARIABLE RESISTORS

INTERNATIONAL RESISTANCE CO.

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IRC makes more types of resistance units, in more shapes, for more applications than any other manufacturer in the world.

transoceanic routes and seven times larger than the DC-3 transport.

The new planes will be used by Pan American in its Latin American expansion program and possibly in other long-distance services. The air line will operate these planes directly to Latin America from New York, as well as from Miami, New Orleans and Los Angeles, at fares as low as 3½ cents per mile. Passengers will be carried from New York to Buenos Aires in 22 hours, to Rio de Janeiro in 19 hours, and from Los Angeles or San Francisco to Honolulu in about 8 hours.

Although dates of delivery to Pan American will depend upon progress of the war and Government decisions on production and man-power priorities, most of the engineering has been completed and the basic airplane of this size is under construction at the Long Beach, Calif., plant of the Douglas Company.

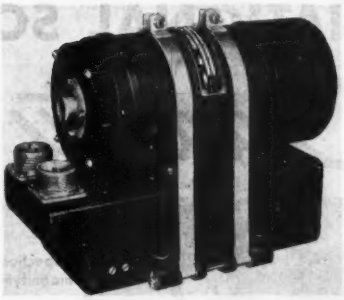
The DC-7 will be powered by four Pratt & Whitney engines of greater displacement than the 2,100-hp. Double Wasp. Details of this new engine are still secret. The plane is also equipped with the superhydromatic Hamilton Standard propeller. It will have two cabins, one accommodating 72 passengers and the other 36, in addition to a modern galley equipped for serving full-course meals, dressing rooms and other passenger facilities, cargo compartment, flight deck, and compartment for pilots. There will also be large storage compartments for food, and electrically operated stoves and refrigerators will be included in the equipment. Thermal deicing systems, built into the wings and other surfaces, will make comfortable all-weather flight possible at high altitudes. Douglas Aircraft Company, Inc.

The A-26 Invader

The A-26 Invader is reported to be in action. This all-purpose bomber is designed to carry such a flexible selection of machine guns, cannon, bombs, and fuel as to make its offensive striking power adaptable to almost any combat situation.

Combining heavy fire power and bomb capacity with great speed, this twin-engined plane was designed specifically for either low- or medium-altitude operations against enemy aircraft on the ground, tanks and troops on the march or in bivouac, towns harboring enemy troops, antiaircraft emplacements, supply dumps, wharves, and naval vessels. One of its unusual features is the "all-purpose nose" which enables it to be equipped on the production line for special missions. This saves a trip to a modification center.

The A-26 is said to be exceptionally clean aerodynamically, employing the N.A.C.A. low-drag (laminar flow) airfoil wing section. It is equipped with twin 2,000-hp. R-2800 series engines. It has a new double-slotted flap that reduces landing speed and assists take-off. The entire airplane has features of maintenance and simplification stressing accessibility to all parts. Douglas Aircraft Company, Inc.



The Eclipse Type 800 motor generator designed to provide a source of a.c. power for radio and accessory operation.

Motor Generators for A.C. Equipment

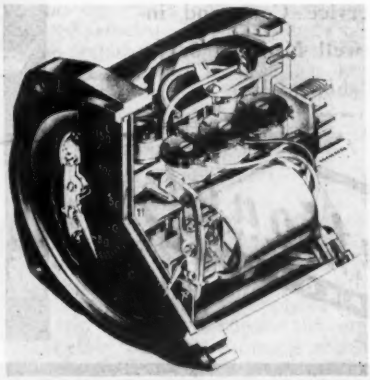
Eclipse Type 800 motor generators are designed to operate from the aircraft d.c. electrical system to provide a source of 800-cycle, constant-frequency alternating current independent of engine-driven generators, for radio equipment and other a.c. accessory operation.

Operation of the motor generator is fully automatic on closing the remote-control switch. An integral carbon-pile voltage regulator maintains a constant a.c. supply of 115 volts over the entire rated operating range of the motor generator.

The Type 800 is essentially a d.c. motor and alternator with rotors on a common shaft. A rotating-field inductor and stationary windings eliminate the use of collector brushes. An integral control box houses a carbon-pile voltage regulator, solenoid starting switch, selenium rectifier, and variable resistors. The unit measures 11 13/16 in. long, 8 9/32 in. high, 5½ in. wide, and weighs 24.5 lbs. Eclipse-Pioneer Division, Bendix Aviation Corporation.

Electrical Thermometer Indicator

A new design of electrical thermometer indicator of the ratio type has been developed and produced in quantity for the Army Air Forces and the Navy Bureau of Aeronautics.



The ratio type electrical thermometer indicator developed by the Instrument Division of Thomas A. Edison, Inc.

This instrument in its present form is made to indicate, in connection with a resistance bulb, the temperature of oil, coolant, carburetor air, carburetor mixture, or free air. It is also being adapted to electrical pressure indication and other aeronautical uses.

The design of this instrument inverts the conventional arrangement of such instruments by using a small moving permanent magnet, the position of which is governed by the currents in two sets of stationary coils. This arrangement is reported to offer a further advantage in the elimination of all hair springs or rotary current-carrying devices and results in a saving of about half of the weight of the conventional instrument.

In common with all indicators of the ratio type, this instrument is almost unaffected by normal variations of battery voltage and, when de-energized, can be arranged to swing off the lower end of the scale. A small rheostat built into the instrument provides a simple and convenient means of recalibration after overhaul. The light weight and small size make it possible to incorporate two, three, or four movements in a standard aircraft instrument case. Thomas A. Edison, Inc., West Orange, N.J.

Fairchild C-82 Packet

The Fairchild C-82 Packet is designed for carrying tanks, ammunition, supplies, troops, or paratroops to distant points of combat and operations. It is powered by two Pratt & Whitney 18-cylinder R-2800-22 engines, with a take-off horsepower of 2,100 each, and has been especially designed for operation into and out of small fields. Its range is reported to be in excess of 3,500 miles.

The large cargo-carrying fuselage provides vertical walls and unobstructed cargo space for its entire length. Adjustable ramps permit large assembled vehicles to be driven directly into its interior. The floor of the compartment is parallel to the ground and stands at the same height as that of a standard platform, so that loading is accomplished directly through hinged doors in the after section of the fuselage. In flight these doors close to form the rear of the fuselage.

The wing is of cantilever design, with a span of 106 ft. The center wing section includes the engine nacelles, which form the forward portions of the twin tail booms It passes through the extreme top portion of the fuselage at the point of maximum depth, a few feet behind the flight deck. From each side of the fuselage, the center section slopes downward to the points where the outer panels are attached to it. Both the center section and outer panels are of two-spar construction, using ribs of Alclad sheet. The outer panels are reinforced both top and bottom by a corrugated skin beneath the flat Alclad covering skin, while the corrugation under the center-section skin is used only on the lower side.

Two fabric-covered aluminum ailerons are used on each outer panel. The

"MADE BY NATIONAL SCREW"

means *Quality Control*

Bench inspection.

Inspection under magnifying glass.

...1944 outlining procedures to be followed in establishing Quality Control Rating for the National Screw & Mfg. Company. The Air Technical Service Command is pleased to advise that Quality Control procedures at your facility are such as to warrant approval. Therefore, the National Screw & Mfg. Company has been listed on the Army Air Forces records as a Quality Control "APPROVED" facility.

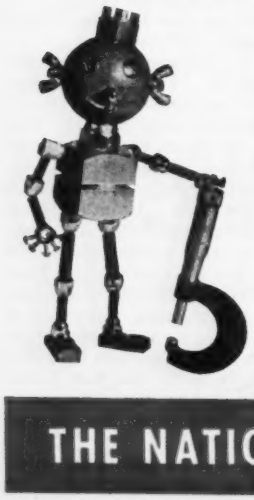
Checking pitch diameters with roller snap gauges.

Magnetic inspection by Magnaflux

As a principal source of supply for aircraft fasteners, we have developed facilities for achieving tolerances formerly unheard of in bolts, nuts and screws.

There is only one way to insure rigid adherence to the quality required by the Air Forces, with a production of millions of parts daily. That is by a system of inspection that is complete and foolproof.

The excerpt reproduced above from a recent letter of formal approval from the Air Technical Service Command indicates how well National Screw has achieved this goal.



National HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

twin tail booms supporting the empennage are of metal monocoque construction. The horizontal stabilizer, as well as the vertical fins, is of conventional Alclad frame and covering. Rudders and elevator have Alclad frames with fabric covering. Two tabs are used in the elevator and one in each rudder. Two slotted wing flaps are used on each side of the wing, one inboard and one outboard of the engine nacelles.

The fuselage is of monocoque metal construction with Alclad sheet and formed longitudinal stringers mounted on fabricated Alclad frames. Seven longitudinal beams take the floor and tie-down loads in the main cargo area beneath the plywood-covered floor. Tie-down fittings are located in the center of 20-in. squares throughout the entire floor area.

The landing gear is of the tricycle type with single wheels. The main wheels retract into the underside of the engine nacelles, and the nose wheel is concealed within the nose section forward of the cargo space. Total vertical travel of the main wheels is $9^1/_2$ ft. Electric mechanisms are used for the operation of all power-actuated devices except brakes, with emergency hand operation mechanisms also provided.

Although the immediate application of the C-82 is for tactical purposes, engineers see in this new craft many varied postwar uses in both domestic and foreign air express and passenger operation. They estimate that the Packet can carry as many as 76 passengers by day and 30 by night in upper and lower berths on both sides of the aisle. As a passenger air liner, the Packet is expected to provide for 50 passengers, a lounge, washrooms, and observation space. Conversion from passenger transport to aerial freighter may be accomplished in less than an hour by removing and storing all passenger seats. Fairchild Aircraft Division, Fairchild Engine & Airplane Corporation.

Field Modifications for Photographic Planes

The small camera compartments in the P-51 photographic planes are directly in the rear of the coolant scoop, where escaping hot air blasts made cameras so hot that photographers blistered their hands when they tried to remove film magazines. This abnormal heat also caused focal plane shutters of the Fairchild model K-22 aircraft cameras to stick and bind half way through tripping cycles, with unsatisfactory photographs resulting.

The problem was solved by cooperation of Army officials with technical representatives of North American Aviation, Inc., the manufacturers of the P-51 and the maker of the cameras. After investigations, the factory men decided they could rectify the trouble without changing basic Army specifications in either the planes or cameras. The plan provided for proper ventilation of the small camera compartments and a way to cut off entry of the hot blast. A cut was made on the plane's access door to serve as a vent. At the point in the camera room where the coolant scoops's actuating rod moves up and down through the bottom of the compartment, a felt pad was installed around the rod to close the opening and eliminate the hot-air blast. The camera opening at the bottom of the compartment was sealed with a canvas cover, with a hole large enough for the lens cone to protrude. This latter device prohibits entry of hot-air blasts, and dirt, dust, and water picked up on runways, and on take-offs and landings are also excluded. Fairchild Camera and Instrument Corporation.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

The Night Owl Camera

The Fairchild model K-19B Night Owl camera is featured by a device that automatically causes the shutter to make an exposure at the point when the light from a flash bomb, dropped from an airplane, is at its peak intensity.

The K-19B has a focal length of 12 in. with an aperture of F2.5 and a between-the-lens type shutter, with three shutter speeds: $^1/_{25}$, $^1/_{50}$, and $^1/_{100}$ sec. Employing either a roll film magazine (9 by 9 in.) or a cut film magazine (8 by 10 in.), it provides for 190 exposures per roll of film or two exposures for cut film. Operation can be either automatic or manual. The camera weighs only 64 lbs.

The camera works as follows: The flash bombs, in the shape of detonation bombs, contain approximately 25 lbs. or more of flash powder, and at the peak of the flash a bomb provides about 1,000,000 cp. A fuse ignites the powder when the bomb is in mid-air at a point behind the plane, and the light developed actuates a phototube and electronic amplifier to open and close the camera shutter. The flash does not show on the negative unless reflected from water in the area photographed. The phototube operates only on a change of light intensity. If exposed to a steady beam of light, it would operate only upon the inception of the light. An interruption or increase in the light intensity would be necessary to work it repeatedly.

The phototube unit contains a motor generator that is used to supply current to a trip magnet that releases the camera shutter. After the shutter is wound, a spring trips a release lever, making the shutter free to operate when the trip magnet releases it. As light falls on the phototube, it causes the amplifier tubes to cut off the current flowing from the motor generator to the trip magnet and permits the shutter to operate through one cycle. As the shutter operates, it trips the case drive, and this allows a second motor or the operator to wind the case drive, shutter, and magazine for the ensuing exposure.

Contained in the phototube and amplifier housing is a shunt-wound motor and a permanent-magnet generator. When operated with 24 volts applied to the motor section, the generator revolves at a speed between 8,000 and 10,000 r.p.m. to provide a terminal voltage of about 130 volts d.c.

An accessory unit for testing the sensitivity of the photoelectric circuit is a pulse generator that is designed to supply the same amount of energy to the amplifier as generated by a phototube when exposed to a light source of 0.2 foot-candle. This eliminates the variables encountered when using a calibrated light source and a phototube as a testing device. Fairchild Camera and Instrument Corporation.

Tail Emplacement for Gun Camera

Usually installed in the wing or nose, the Fairchild machine-gun camera, weighing only 3 lbs., is now being tried in the tail of the P-51 Mustang. With this arrangement, its 35-mm. film not only photographs the flight direction of bullets toward the enemy plane targets but shows the pilot-gunner in action during battle. The resultant pictures are centered instead of off to one side, and, because the film includes the pilot, it gives a clear and comprehensive view of the action.

A more important advantage of this new installation is that the camera, when placed in the plane's tail, is removed from the guns and engines. This reduces vibration considerably and makes for sharper, clearer motion pictures. Also, the instrument is more easily accessible for boresighting, changing of magazines, and general servicing.

The arrangement is still in the experimental stage, but reports of performance in actual use are favorable. After necessary tests have been completed and certain readjustments made, the tail emplacement for the gun camera may become standard in all types of war-front fighter planes. Fairchild Camera and Instrument Corporation.

Proposed Specifications for a Feeder-Line Airplane

The following specifications for a potential "Feederliner" represent the combined opinions of a committee appointed to study the principal requirements for an airplane to serve on feeder air lines. The committee decided that in presenting these specifications as much latitude as possible should be allowed the designer. Therefore, with the thought in mind that the manufacturer will design an airplane with an initial price that will permit him to sell his product and that will operate at a minimum per-mile cost, the committee has refrained from laying down too rigid rules pertaining to dimensions of air-

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A New Altimeter Test Unit for Testing Altimeters and Rate-of-climb Indicators

THIS new unit is very compact, and simple to operate. It consists of chamber, integral vacuum pump, control valves, and electrical equipment.

It is complete requiring no other accessories for complete testing of altimeters when using a master standard altimeter.*

**A standard Meriam well type manometer can be furnished with scale graduated directly in altitude if required.*

THIS **Altimeter Test Unit** fills a long standing need in the field of testing.
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Unit with cover open

Among the many features of the Meriam Altimeter Test Unit are:

1. Chamber designed for testing four instruments at one time.
2. Internal instrument mounting plate removable from chamber for independent mounting of instruments.
3. Vibrator included which eliminates drag on indicating pointer of instruments.
4. Heavy duty vacuum pump which will evacuate chamber to 2 inches of mercury absolute or equivalent of 60,000 feet.
5. Metering valve for accurate control of vacuum exhaustion and rate of vent.

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plane, weights, horsepower, landing speeds, etc.

In order to obtain a maximum in safety and performance and to permit operation into small, restricted airports, it was unanimously decided to limit the landing and take-off runs to a maximum of 1,000 ft.

Seating capacity of 18 to 22 passengers is specified, at 200 lbs. per passenger including baggage, with a moveable bulkhead between the passengers' section and the forward cargo compartment that will permit the removal of forward seats and the enlargement of the cargo compartment in approximately 10 min. To eliminate the necessity of checking each passenger's baggage, a space or a rack shall be provided so that each passenger will handle and be responsible for his own baggage. Also incorporated in the design will be the ability to seat passengers without consideration to load distribution. This will eliminate the necessity of assigning seats and will permit a substantial timesaving. To permit quick loading and unloading, the passenger door shall be at least 30 by 70 in. The forward cargo door is to be 60 by 60 in.; the rear cargo door, 30 by 30 in. All doors are to be on the left side. A high-wing design was chosen to permit greater vision for both pilots and passengers, and for easier loading and unloading on the ground.

The airplane will be of all-metal construction. To provide maximum safety and to conform with present C.A.A. regulations, the airplane will be twin-engined with single-engined performance. The airplane will be equipped with complete instrument and night-flying equipment and full-feathering propellers. Landing gear will be a retractable, tricycle gear designed to permit landings in cross winds of at least 20 m.p.h.

Since landings in feeder-line operation will be made on an average of every 50 miles, or possibly less, and since, at the outset, a large percentage of these landings will be made on turf runways, the airplane must be equipped with a rugged landing gear and braking system and with oversized tires.

A cruising speed of 170 m.p.h. has been decided upon, with a cruising range of 500 miles plus the usual fuel reserve. To permit operation into small airports in congested areas the gliding angle has been set at 7 to 1.

Visualizing a large increase in air mail and cargo in the immediate postwar future, the committee has set the cargo capacity at 2,000 lbs. This will include pickup gear if used. The airplane shall be designed structurally to permit the installation of a pickup unit at any time without structural changes. It shall be stressed for a maximum pickup load of 300 lbs., using a unit similar to that in present operation. Complete pickup unit will not exceed 100 lbs. in weight.

The airplane will be designed and powered to deliver maximum performance at an altitude from 500 to 1,000 ft. above the surrounding terrain and shall have maneuverability and complete control at 80 m.p.h. or less.

To achieve an average of 60 sec. of ground time at each intermediate stop, ground-equipment requirements call for the following: (1) under-tank refueling system, which will eliminate the necessity of climbing to the top of the wing at each refueling stop; (2) retractable passenger steps that will automatically lower into place when the passenger door is opened; (3) if possible, a minimum of eight bins shall be provided under the floor with individual outside self-locking doors for small mail and express packages destined for separate points en route. For passenger comfort, the specifications provide for air conditioning, reading lights, toilet facilities, and call buttons. Feeder Airlines Association.

Glue for Bonding Synthetic Rubber to Metal

An adhesive has been developed for bonding synthetic rubber to metal. The new cement not only eliminates the need for brass plating but is also credited with providing a more uniform adhesion than the brass-plating method. It is stated that the presence of spots of water or rust film does not affect this glue. Attention is called to the particular value of such an agent in bonding rubber to aluminum. Firestone Tire & Rubber Company.

Flying-Rocket Launchers

One of the plants of the Firestone Tire & Rubber Company has been reconverted to the manufacture of rocket launchers which combat planes are using against enemy ground forces.

The rocket-launching tubes are 10 ft. long and $4^1/_2$ in. in diameter. Three tubes are formed into a cluster, and clusters are mounted under the wings of aircraft, one cluster under each wing. The launchers are made from magnesium or from plastic-hardened paper. A complete launcher produced from magnesium weighs only 85 lbs., and a paper one still less. The launchers are discharged electrically, and each tube fires only one rocket shell before reloading is necessary.

The launchers are adjustable to fit the P-38 Lightning, P-39 Airacobra, A-20 Havoc, and A-36 Invader. They are held in place by attachments similar to those used when auxiliary gasoline tanks or bombs are fastened to the aircraft. Firestone Tire & Rubber Company.

Automatic Temperature Control for Fighter Planes

An automatic temperature control system designed primarily for fighter planes allows pilots more time for their main purpose of fighting by performing automatically an essential flight operation for them. The system electrically operates the flaps that regulate the flow of air to the engine. It employs a temperature-sensitive material that automatically controls the cooling of the engine head, oil, and carburetor air or coolant temperature, whichever the case may be.

In the new system the temperature-sensitive material, a combination of metallic oxides, starts opening the flaps at a predetermined temperature. When the highest allowable operating temperature is reached, the flaps will be fully open. Using a relay of only $^8/_{10,000}$ watt in power, the modulating control can stop the flaps at any position between open and closed, the position depending on the temperature of the engine. General Electric Company.

Portable Flashing Beacon for Temporary Airports

A portable flashing beacon, using a gaseous-discharge lamp of a type originally developed for ultra-high-speed photography, has been designed for identification-signaling at temporary airports. It uses only one-third the power required for a stationary airport rotating beacon and weighs only one-third as much. Mounted on a collapsible mast, it produces a coded flash of such intense brilliance that its exact candle power cannot be measured.

Power for this flashing beacon is supplied by a portable gasoline engine generating set. The beam unit with its associated control unit fits into a small steel trunk with compartments for storing the beacon head, cable, lamps, and tubes. Equipment includes a transformer, vacuum-tube rectifier, capacitor, flasher, and an electronic relay for controlling the signal flashes. A choice of five codes is possible simply by rotating a selector switch built into the control unit.

The flashes are obtained by charging the capacitor by means of the transformer and rectifier and discharging it through the lamp. Cam-operated contacts driven by a synchronous motor actuate the electronic relay to time the frequency of the flashes. The intensity and duration of the flashes is inherent in the design of the lamp and power pack. The coding consists of timing the interval between flashes.

The beacon lamp is enclosed, for protection and light control, in a dome-type Fresnel lens which emits the light at all angles above horizontal with maximum candle power at about 5° above horizontal. The lamp operates at 2,000 volts d.c. potential. The complete unit operates on 115 volts a.c.

As a safety measure the outfit is provided with an electrical interlock so that when the auxiliary cover over the power pack is lifted, the main power supply is shut off and the high-voltage condenser is short-circuited through a safety discharge relay. This relay operates whenever the power supply is shut off. General Electric Company.

High-Tensile Electrodes for Arc-Welding Aircraft Steels

Type W-55 high-tensile arc-welding electrode for fabricating aircraft steels is reported to be capable of making a deposit of high-tensile strength comparable to the mechanical properties of

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the parent metal. It is especially designed for use in the manufacture of heavy bombers and transport planes. It can be used for welding in any position, including vertical welding from the top down and from the bottom up. Therefore, it is particularly recommended by the manufacturer for welding engine mounts and fuselage assemblies. The arc can be struck at the top of the joint and maintained while welding vertically downward, then overhead, then vertically upward again to the starting point.

Arcing characteristics of the W-55 electrode provide flexibility over a reasonably wide voltage range with stable operation throughout. The arc has sufficient force to keep slag from crowding the electrode when welding vertically downward, and the metal sets up quickly when welding overhead and vertically upward.

Characterized by its gray extruded coating, the W-55 electrode is recommended for operation on direct-current straight polarity or alternating current. A medium to long arc is recommended for best results. The W-55 is available in three sizes: $^{3}/_{32}$ by 12 in., $^{1}/_{8}$ by 14 in., and $^{5}/_{32}$ by 14 in. General Electric Company.

Daylight Measurement of Cloud Ceilings

A pulsating light system with a photoelectric detector has been developed for consistently accurate daylight readings of the cloud ceilings. With this system, it is claimed, clouds as high as 2 miles can be measured in daylight.

The complete device consists of a mercury-arc projector; a pickup unit, known as a ceilometer; and a recorder that provides a continuous record of ceiling height and relative cloud density. A small, superhigh-intensity quartz mercury lamp is mounted at the focus point of a searchlight mirror to throw a 120-cycles-per-sec. pulsating beam vertically into the sky. The beam, although not visible to the human eye in daylight, is scanned readily by the ceilometer. This unit consists of a phototube pickup and amplifier feeding to an output meter. It is located 1,000 ft. from the projector and is tuned to the same frequency as the light pulse in order to distinguish the mercury-light signal from background light. Scatter energy, produced on cloud layers dense enough to scatter the beam, is detected as the ceilometer scans the beam. A Selsyn drive, between the ceilometer and the recorder, translates the position of the ceilometer into cloud heights on the recorder.

Since the quartz lamp operates at an extremely high temperature, it must be cooled. A high-pressure jet method of air-blast cooling has been devised, good for any temperature conditions normally encountered. The air-cooling mechanism consists of a motor-driven compressor enclosed in a weatherproof housing. The entire device operates from a 60-cycle, 110-volt a.c. line. General Electric Company.

Flexible Rubber Coupling

The Flexlock rubber coupling that has been used in many parts of the pipe-laying field has now been adapted to aircraft uses. The coupling is effective as a seal or as a flexible joint and is particularly useful in applications where vibration might cause metal-to-metal couplings to fail.

The coupling is a gasket or ring having ribs or fins running circumferentially both inside and outside. Inside fins not only grip the outside surface of the smaller pipe, but also provide a maximum sealing pressure. The outside fins are so designed that as the deformation of pack takes place and they grip to the bell or sleeve of the outer pipe, they also set up strut action through the cross section of the coupling, driving the joint tighter.

The result of the gripping action of the inside fins and the sectional thrust caused by their deformation is a tight joint. Through the design of the outward lips the only effect of internal pressure is to drive the gasket up the tapered seat, wedging the rubber into a tighter packing position.

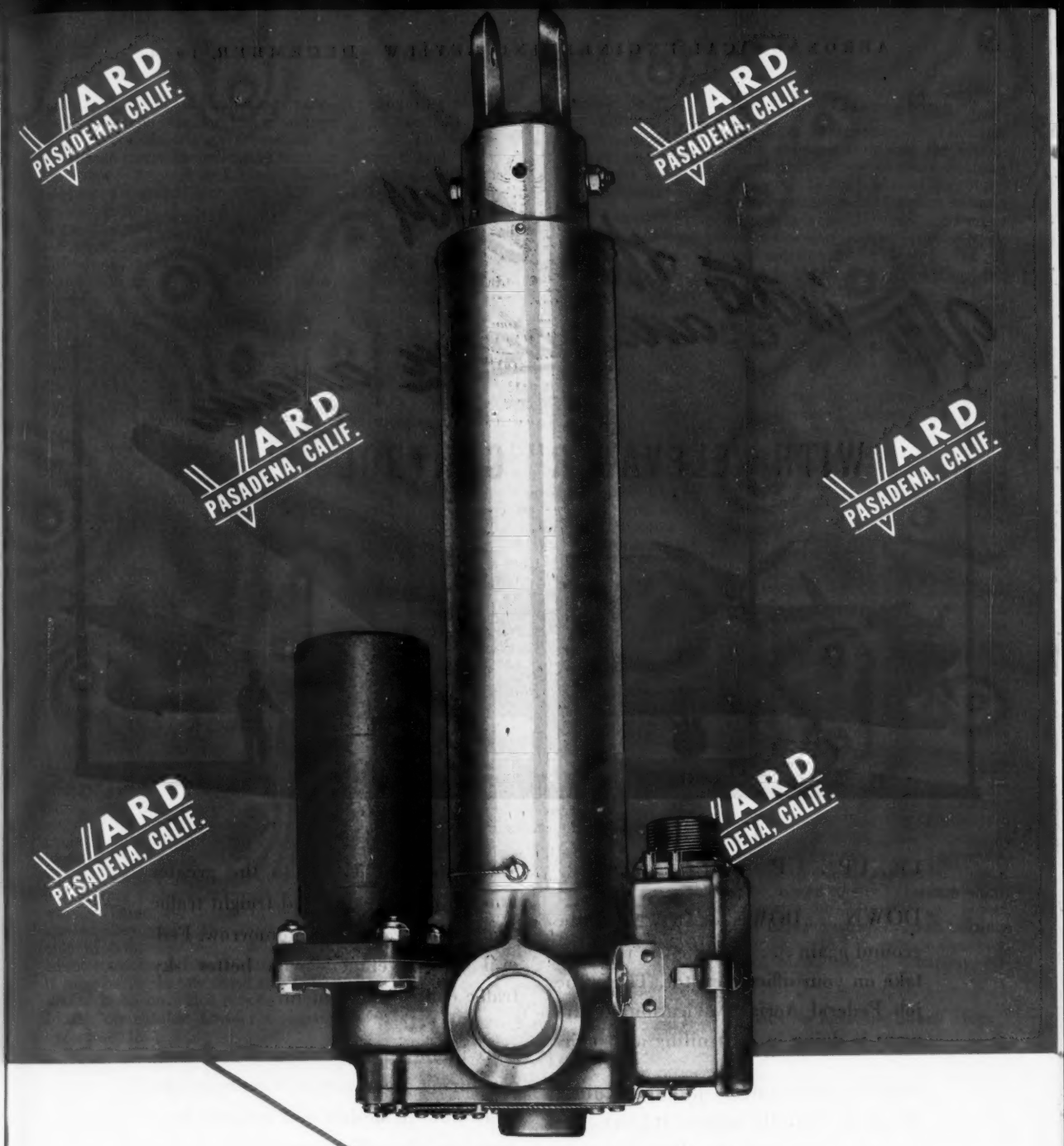
For aeronautical uses the couplings can be made of either natural or synthetic rubber, depending upon service conditions. Various compounds to meet specifications have heat ranges from −50° to 150°F. and can be made resistant to petroleum products and aromatics as well as hot and cold gases and liquids, the latter including commercial acids, alcohol, water, gasoline, and oil. The couplings are stated to be effective as a high-pressure seal for either internal or external pressures.

Present applications of the coupling in the aircraft field are as high-pressure grommet seals, for passing lines into or through liquid containers such as integral fuel tanks, for passing conduits through bulkheads of pressure chambers and cabins, as a flexible joint for wiring or control-cable conduits, and as a flexible joint for bell and spigot tubing for the transferring of gases and liquids. For aircraft use the couplings are being made for $^{3}/_{4}$-, $^{7}/_{8}$-, 1-, 1.20-, $1^{1}/_{2}$-, 2-, $2^{5}/_{8}$-, and 3-in. outside diameter pipes or tubing. The B. F. Goodrich Company.

Propeller-Governor Test Machine

An automatic push-button-controlled universal propeller-governor test machine features simplicity and speed of operation. Variable speeds at variable displacements, to simulate actual flight conditions, are obtainable by means of a simple adjustable lever on the machine. The feathering system is identical to that of an airplane system.

This machine is designed to permit experimental or service testing of various types of governors under different conditions. Automatic electrohydraulic controls are interlocked to prevent damage through misoperation of the machine. A single selector switch on the panel quickly and automatically sets the entire machine for all test requirements on the type of governor to be tested.



We are glad to announce that VARD INC. is now manufacturing electrically powered, mechanical actuators for aircraft.

This addition completes our line, as we have built hydraulic cylinders, valves, switches and fluid actuators for several years.

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UP... UP... UP into the sky!

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Internal leakage is indicated automatically. The machine has a voltage regulator for electric governors and a percentage meter for indicating hunting conditions. A quick-lock clamp facilitates mounting and dismounting of governors. A total of $7^1/_2$ hp. is available to provide ample power for all test requirements. A convenient work table with drain, a tool drawer, and an enclosed shelf are built into the machine. Propeller governor types that the machine tests, calibrates, and adjusts include Hamilton Standard, constant speed, hydromatic, double-acting, and Curtiss proportional and constant speed. Greer Hydraulics, Inc., New York.

A-26 Propellers

The propellers of the Douglas A-26 Invader are reported to be three-bladed hydromatics, 12 ft. 7 in. in diameter, geared to one-half the r.p.m. of the 2,000-hp. Pratt & Whitney engine. Blades are of standard alloy Duralumin and of conventional shape. They have rounded shanks and incorporate the Clark-Y airfoil. These propellers are manufactured by Nash-Kelvinator Corporation of Lansing, Mich., and Remington-Rand, Inc., of Johnson City, N.Y., both licensees of Hamilton Standard Propellers Division, United Aircraft Corporation.

Universal Chuck

A new Universal three-jaw chuck has a body of fine grain, high-tensile-strength semisteel. Ample resistance to shock, load, and unusual stress is provided by rib construction. The scroll is made of alloy steel and has heavy proportions to assure true turning and long life. Two sets of jaws are provided, one for internal and the other for external work. These are made of specially treated alloy steel. The chuck is available in 5-in. size only. A mounting adapter comes with each chuck so that it may be accurately fitted to the particular lathe on which it is to be used. Ideal Commutator Dresser Company, Sycamore, Ill.

Combined Still and Motion-Picture Camera

The Jerome data-type electric still and motion picture automatic camera is described as four cameras in one. Primarily designed for use as combination data-type still and data-type motion-picture cameras, they also may be used as ordinary still cameras or motion-picture cameras.

Built into each camera is a timing mechanism that controls the taking of single- or multiple-frame photographs at definite time intervals. The range of this time is from 15 sec. to approximately 30 min. The plano-focal shutter made of rubberized silk is used for the taking of single-frame pictures, while the rotary shutter operates for motion-picture applications.

Because of the heater, thermostat, and other engineering requirements, each model of the camera will work properly only on the current for which it is built. The manufacturer is now producing models for operation on 6, 12, and 24 volts d.c. and 110 volts a.c. The 24-volt camera will operate on 6 and 12 volts at slower speeds and also will operate on 110 volts a.c. by the employment of a transformer of approximately 30-volt reducing power, provided the heating feature is not required.

The lens turret is approximately $4^1/_2$ in. in diameter in all models and accommodates one of three lenses. It is of the revolving type and snap locks into the desired position. Unless otherwise specified, the camera is supplied with a 1-in. Wollensak, anistigmatic F4.5 or a 2-in. Wollensak velostigmatic F2.8 lens or equivalents. Focusing devices consist of a large-size view finder (approximately $2^5/_{16}$ by 2 in.) made of plano concave optical glass secured on a metal frame. For additional focusing, a right-angle prism is provided behind the film. Focusing can be done with a ground film mask (provided with camera) or made directly through the emulsion of raw stock of new film. This also enables the photographer, when taking motion-picture scenes and single-shot scenes to check at will at any time, without opening the camera, by merely sighting through the peephole. A magnifying lens is provided inside the camera.

For locking the film into position a solid gate of two pieces is used, between which the film is inserted. By holding the film in a straightened position in the gate housings, the necessity of using registering pins and the chances of perforation of the film when it gets out of register are eliminated. Six holes in the film engage the sprockets at all times. Jerome Engineering Company, Massapequa, L.I., N.Y.

Alloy for Cutting Tools

A cast nonferrous alloy made up principally of chromium, tungsten, and cobalt is offered for cutting metal to bridge the gap between high-speed and cemented-carbide cutting tools. Its hardness range is from 60 to 62 Rockwell C, and only one point drop in hardness is noted at temperatures ranging as high as 1,900°F.

The new tool is cast to shape and is used in the as-cast condition after being surface ground. Peak efficiency is realized when cutting at speeds from 20 to 80 per cent over the top speeds for high-speed tools. Because of the inherent toughness of the tool, intermittent cutting even of chilled castings is reported to be possible. Other characteristics of this alloy are that it cannot be hot-worked and it is not susceptible to heat-treatment.

The manufacturer is able to furnish both flats and squares for toolholder bits or for milling-cutter inserts, surface ground to tolerances of 0.000 and −0.005 in. Round sections will be centerless-ground to the same tolerances. Die inserts or other complicated sections will be furnished in the as-cast condition. Jessop Steel Company, Washington, Pa.

Ball-Bearing Cleaning Machine

The L & R precision ball-bearing cleaning machine combines the rotary principle with a new pressure-cleaning mechanism. In the basket of the rotary cleaner, from 50 to 100 bearings of various sizes may be precleaned. In the pressure-cleaning tank, continuously filtered solution under 6 to 10 lbs. of pressure is forced around each bearing individually. Filtered compressed air is provided to remove surplus solvent from the bearing while it is still on the pressure-cleaning spindle. The solvent used is L & R Instrument Rinsing Solution.

The bearing on the pressure cleaning spindle is rotated alternately clockwise and counterclockwise to obtain maximum surface coverage by the solvent. The coned head into which the bearing fits to receive the cleaning compound is stepped to accommodate eleven sizes of bearings. This unit is standard; others can be made to conform to sizes of bearings according to individual specifications.

The tank in which the pressure-cleaning mechanism is located is sealed during its operation. The process may be observed through the glass lid, with visibility aided by a plastic hooded lamp located within the tank, opposite the spindle. With minor changes the machine can be adjusted to clean gears and other small assemblies with or without ball bearings.

The basket of the rotary cleaning unit measures $5^1/_2$ in. inside diameter by $3^3/_8$ in. deep. Total weight of machine is less than 200 lbs. All controls are mounted on a single panel located at the front of the machine. The equipment is fitted with casters so that it may be moved to any point in a plant. It operates on 110-volt a.c. power. Model 100 is designed to clean bearings measuring up to 2 in. outside diameter. L & R Manufacturing Company, Arlington, N.J.

Device for Installing Shock Rings

A tool for installing shock rings on Piper Cub and Taylorcraft planes is being produced. Called the LaPointe Shock Ring Jimmy, the device is a curved steel bar with a swivel head that snugly fits the end of the retaining arm on the shock strut.

One end of the bar is slipped through the shock ring, the head on the other end is fitted to the retaining arm, and then the end of the bar is drawn up and over the shock strut. The shock ring slides down the handle, over the head, and into place. LaPointe Engineering Company, Unionville, Conn.

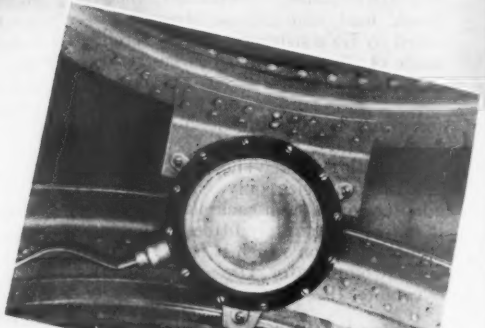
Plastic Caps Protect Hydraulic Tubing against Dust

Nearly one million small red, ivory, and blue plastic protective caps are used each month to cover the open ends of tubing in the hydraulic system of the Lockheed Lightning P-38 fighter. Patented and manufactured by the Southern California Company of Eagle Rock, the caps were designed by engi-

America's Mightiest War Bird

...THE BOEING B-29 SUPERFORTRESS... IS EQUIPPED WITH Standair VAPOR-PROOF CABIN LAMPS

Embodying innumerable aerodynamic refinements developed by Boeing engineers and the A.A.F. Materiel Command, this new aerial dreadnaught carries the greatest load faster, farther, and higher than any other airplane in existence. It is equipped with Standair Type A-7 Vapor-Proof Dome Lamps. The Type A-7 Lamp, due to its special construction, is moisture-proof — impervious to any vapors that may be present in the cabin. Provides a clear, brilliant light regardless of varying atmospheric conditions. Sturdily constructed to withstand shock. Weight 1 lb. 10 oz. Overall length 6⅞". Diameter 5⅞". AN 3039. Standard Aircraft No. SA-2672-B. Write for details, prices.



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KEEP ON BUYING WAR BONDS

neers for that company with the assistance of a Lockheed manufacturing engineer.

The caps are made in three styles to meet the three types of opening to be capped: (1) snap-on caps, for use on beaded ends of tubing; (2) snap-on plugs, for use on flared tubing ends (this cap has an integral plug that fits inside the nut and binds the nut, sleeve, and plug together, thereby protecting the nut threads); (3) quarter-lock caps, for use on male fittings, particularly on hydraulic assemblies such as the shear beam plumbing assembling located in the leading edge of the P-38 center section.

All three types are basically the same, being made of the same material, a Tenite cellulose butyrate under a formula worked out and patented by Tennessee Eastman Company engineers. They have similar features of construction and can be turned out at a rate of two per minute per machine for the snap caps and slightly longer for the other types. The caps or plugs are attached to the tubing ends by hand and are quickly removed by the fingers or a pair of pliers. Lockheed Aircraft Corporation.

Suggested Flying-Boat Terminal

Designs for flying-boat terminals for large cities have been developed by engineers of The Glenn L. Martin Company to provide adequate handling facilities in high-density traffic ports.

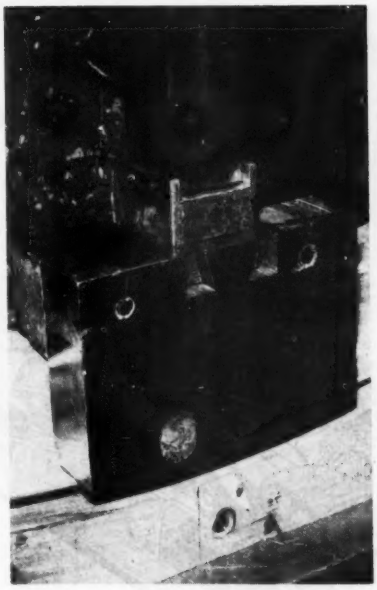
The Martin terminals would be relatively inexpensive and require no great area of land, using only a strip of harbor shore line for terminal buildings and service hangars. One design is in the shape of a pier, jutting into the harbor, with floating tidal docks for the loading and unloading of passengers, mail, and cargo.

Another design is a circular affair built offshore in the harbor and requiring little shore space. The terminal building is in the center of the circle, and the tidal slips are arranged around the perimeter of the circle. A tunnel would connect the terminal to the land. Still another design would be built along the shore line and would employ a system of high-speed cables for handling the beaching and launching of the vessels.

As an integral part of the plan, an unusual horsehoe-shaped tug of high maneuverability has been designed for handling and docking the flying vessels in congested harbor waters. The tug is equipped with three high-performance outboard engines, so mounted as to permit it to revolve in a complete circle, allowing the tug to turn a flying boat practically within its own length. These tugs would meet incoming vessels taxiing in from the water landing areas and would tow laden craft from the terminal to free water for the take-off. The Glenn L. Martin Company.

Self-Locking Form Blocks

Self-locking form blocks are credited with an almost 50 per cent reduction in the forming time of heavy extrusions and bent-up sections. It is claimed that they have also resulted in a 68 per cent production increase. Under the new method, a steel block with a dovetail slide is attached to the ram on the arbor press, with previous form blocks being reworked so they can be fitted into the dovetail slide. This eliminates the locating, holding, and clamping of form blocks required by previous forming methods and permits the operator to work the arbor press with one hand while working the part back and forth with the other. The Glenn L. Martin Company.



Self-locking form blocks, devised by Glenn L. Martin engineers, eliminate locating, holding, and clamping of form blocks required by previous forming methods.

Loading Dock for Large Seaplanes

To facilitate handling of mail and cargo carried by the Martin Mars and to simplify servicing and maintenance of the flying boat, the U.S. Navy has constructed a special U-shaped seaplane dock at the Alameda Naval Air Station.

The basic structure consists of standard Navy pontoons over which a 3-in. wire mesh concrete deck has been laid after covering the crevices between the pontoons with tar construction paper. The floating dock itself is shaped like a U and provides platforms at either side of the aircraft which may be raised or lowered to a convenient height by taking on or removing ballast from the pontoons. The dock contains compressed-air lines, water lines, gasoline lines, fueling pits, electrical connections, and a fire-extinguisher pit, which are connected to the pier and shore by use of rubber hose and flexible conduits.

The Mars is berthed by cables running to fixed electric winches anchored in concrete foundations on the shore at angles from the centerline of the pier loading to the floating dock. The pier itself is so built and joined to the road serving it and to the floating dock that tractors may operate on it, drawing freight cars directly alongside the flying boat for the loading and unloading of cargo.

The new facility is speeding loading and unloading of the aerial freighter to such an extent that the Mars is now operating on a 5-day turn-around basis. It is also serving an important purpose by demonstrating the ease and economy with which ultramodern facilities for the handling of seaplanes can be constructed in the harbors and waterways of the world's centers of commerce and population. The Glenn L. Martin Company.

Inspection of "Blind" Rivets

A bore or rivetscope that is 110 in. long with only a $^5/_8$ in. outside diameter was developed by the Lenox Instrument Company in collaboration with engineers of the Martin Inspection Department to check blind rivets in a new-type wing construction. The structure would not admit most existing borescopes and could not be reached throughout its entire length by those that it would admit. Prior to the designing of the new instrument, it had been necessary with this type of construction to X-ray the entire wing and piece the pictures together in order to determine whether the individual rivets were properly set.

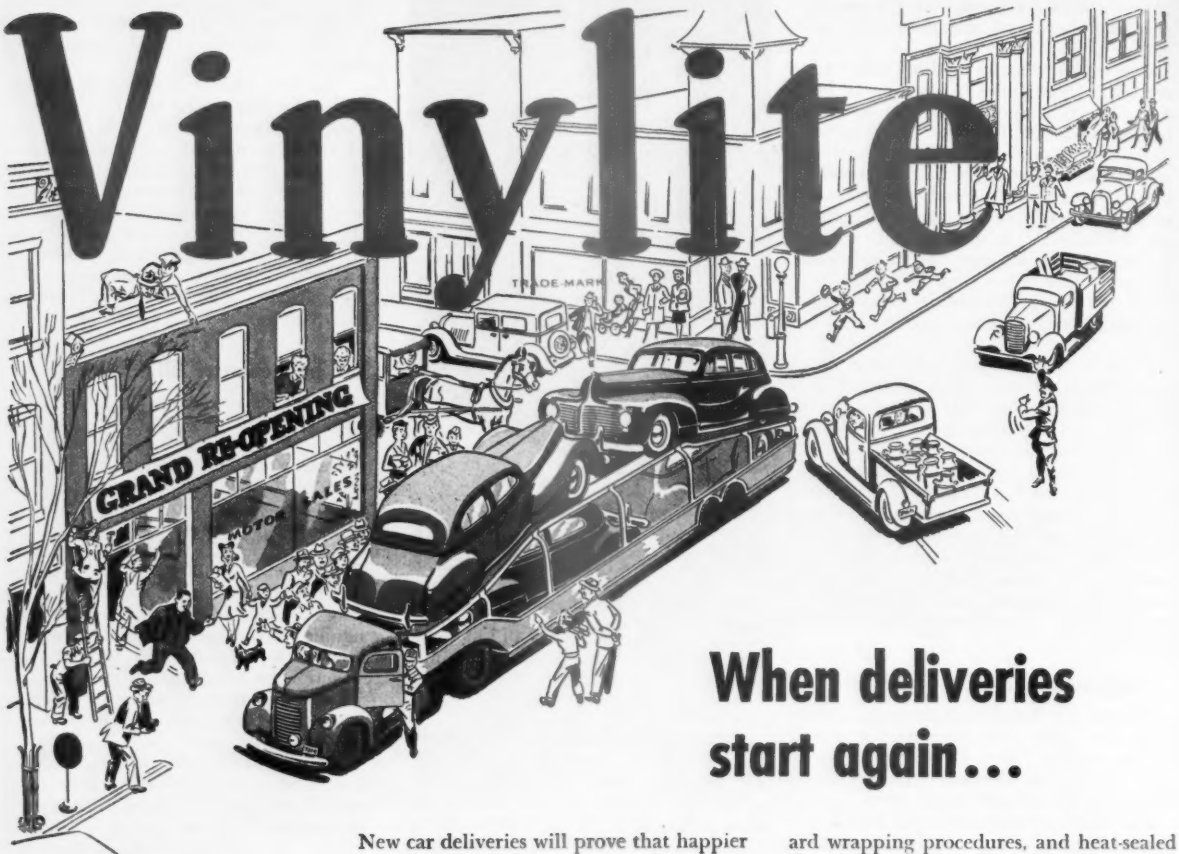
The new Martin rivetscope consists of a one-piece seamless-steel outer tube and a seamless-steel liner that spaces approximately 20 Achromat and simple lenses. A standard eyepiece is provided at one end, together with a connection for a 6-volt transformer, while the other end carries a light and mirror similar to those in a conventional borescope. Because of the length of the tube, the lenses are ground to provide a 2-X magnification at the eyepiece. All wiring in the new instrument is carried internally between the outer tube and inner liner, with the outer tube itself serving as a return to complete the circuit.

A metal foot that rides over rivets is provided at the scope end of the tube to facilitate sliding it into long narrow sections such as corrugations, although this foot may be removed when desirable from the standpoint of clearance. The outside tube is scaled in feet and inches to aid in determining the location of any defective rivets disclosed by the scope.

Further aid in handling the new instrument has been provided in the form of wooden stands containing a plastic roller that may be adjusted to the height of the entrance to the structure being inspected. These stands support the rivetscope during inspection of rivets close to the opening and, at the same time, serve to point out its presence and reduce the possibility of accidental damage.

The new Martin rivetscope is of rigid construction with little "whip," yet it weighs only 10 lbs. complete and can be easily handled by women employees. In addition to the purpose for which it was designed, it is providing the answer

Vinylite



When deliveries start again...

New car deliveries will prove that happier days are here again. Though they look like prewar models, they'll be better cars—improved in many ways. Harness-type wiring systems wrapped in VINYLITE plastic tape, for instance, will be far safer and more dependable than any former assemblies. This unique tape is used on the multiple circuit harnesses of almost every combat vehicle and truck that's built today.

VINYLITE plastic tape gives wiring harnesses 8-way protection. It is non-flammable, eliminating the fire hazard. It is non-oxidizing and permanently flexible; has high dielectric and high tensile strength; resists chemicals and abrasion. Moisture, oils, and grease find it practically immune to their deteriorating action.

But that's only part of the story. VINYLITE plastic tape revolutionizes the *production* of wiring harnesses. It is applied by standard wrapping procedures, and heat-sealed by baking for only 15 minutes, at 265 deg. F. No varnish is used. No additional baking—no cleaning of terminals. Production time cut from 24 hours to 24 minutes.

Besides their use as insulating tapes, VINYLITE plastics are available as extrusion materials for primary insulation, tubular jacketing, and conduits. Wherever used, they bring new economy and safety to the electrical wire and cable field. You will probably find them a real investment in connection with your own products, present or planned. Write for descriptive booklet 12-VR, "Vinylite Plastics for Wire and Cable Insulation."

BAKELITE CORPORATION

Unit of Union Carbide and Carbon Corporation

UCC

30 EAST 42ND STREET, NEW YORK 17, N.Y.

Plastics

to a wide variety of inspection problems, ranging from inspection of an occasional defective rivet in PBM bomb bay fairings, without removing the skin, to examination of long lengths of defective tubing. The Glenn L. Martin Company.

Plating Rack

A new-type plating rack is used in the handling of small aircraft parts. Of simple construction, the new rack does away with the individual hanging of numerous small parts. At the same time it ensures that the surface to be plated faces the anode, thus assuring uniformity of metal deposit and cutting down on rejects caused by uneven coating. A further advantage is that it provides a safe, efficient means for draining parts as they are removed from the baths, while protecting the operator's hands and clothing from the caustic solutions.

The basic design of the rack consists of a tubular metal framework across which wire mesh is stretched. Some of the frames are covered with chicken wire and others with a larger-mesh material to accommodate various sized parts. The mesh-covered frame is attached to another piece of pipe by two arms, with pivots slightly above midpoint so that it can be easily tilted in either direction.

In use, parts are placed in the frame by slipping the ends through the wire mesh where they are held in place by the natural pressure of the wire. Parts that do not adapt to this procedure can be hung on the rack by small wire hooks. It has been estimated that use of the new racks has cut loading time in half, since the previous method required the individual hanging of each part.

When the rack is loaded, it is picked up by the top bar by an overhead conveyer and carried to the plating bath, where it is tilted to either side to ensure complete drainage, and then carried to the point where the plated parts are unloaded. Throughout the whole operation it is unnecessary for the operator's hands or clothes to come in contact with the plating solution. The Glenn L. Martin Company.

Improved Rack-Type Gear Finishers

An improved postwar model of the Series 900 rack-type crossed-axis gear finishing machines is completely hydraulic in operation. It incorporates two separate hydraulic systems, one for the operation of the table and one for the head feed.

Lubricants and coolants have separate outlets, thereby reducing the possibility of one contaminating the other and also permitting the ready use of coolant coolers if needed. In addition, automatic lubrication has been extended to the rack table-ways. These are of hardened and ground dovetail design rather than the inverted-V type and incorporate improved adjustments for wear.

Improvements have also been provided in the control system to facilitate holding tolerances to closer limits than previously. During the cutting cycle the work is reciprocated at a predetermined rate of speed across the rack, while the rack reciprocates longitudinally in mesh with the work. Controls for both rates of speed are quickly adjustable. A positive counter is provided to regulate the number of "finishing" strokes desired, after vertical feed has been completed, to bring the work to correct size on pitch diameter.

Electrical controls have been improved from a safety and durability standpoint, with start and stop button stations operating on 110 volts rather than on power-line voltage. Increasing the structural ribbing in the base and column has resulted in the strengthening of the machine. The hydraulic downfeed mechanism is supplemented by a more positive control for the finishing strokes at the end of the automatic down-feed.

The new machine is designed to finish gears up to 8 in. in diameter with maximum length between centers of $18^1/_2$ in. The design permits precompensating for possible heat-treat distortion of gears subsequent to finishing. The free-cutting action of the serrated racks themselves is intended to eliminate the chance of cold-working of gear-tooth surfaces. Michigan Tool Company, Detroit.

Means of Fabricating Large Plastic Items

Technicians are claimed to have perfected a new synthetic resin that, when properly used in a low-pressure lamination process, will all but eliminate size as a restrictive factor in postwar plastics. With the application of this material for plastic products, heavy compression or injection-molding machines will not be needed, and manufacture will be simplified by the use of existing three-dimensional items, such as forms or molds.

To produce a plastic item, the postwar fabricator will first make a textile coat to fit either the outer or inner dimensions of an existing model of that item. The textile coat then is impregnated with the resin, slipped on or into the mold, and baked for about 10 min. after the center of the laminate reaches the temperature of boiling water. Prospective uses already listed include airplane subassemblies. Monsanto Chemical Company, St. Louis.

For Measuring X-Ray Reflections

The new Geiger-counter X-ray spectrometer is intended to provide an accurate method for measuring distribution and intensities of X-ray reflections. It offers a rapid means for directly determining location and intensity of diffracted rays.

A scanning device, having a Geiger counter tube arranged to traverse a graduated quadrant, is used in combination with suitable scaling circuits. The intensity measurements are quantitatively accurate and can therefore be used to determine composition of crystalline mixtures. Quantitative analyses of mixtures can be obtained in a matter of minutes.

In actual operation, the specimen inserted in the specimen holder intercepts the X-ray beam and deflects portions of it at various fixed angles. When the Geiger counter tube is moved around its quadrant, it measures angular displacement and intensity of the deflected beams. A d.c. microampere meter reads intensity, and the quadrant, marked in degrees, shows diffraction angles. A stepping counter, employed in conjunction with a specially developed scaling circuit, provides a means for exacting quantitative determination of intensity.

The spectrometer is applicable in the analysis of paint pigments, boiler scale, engine wear and lubrication, ceramics and refractories, metal powders, and alloys. North American Philips Company, Inc., New York.

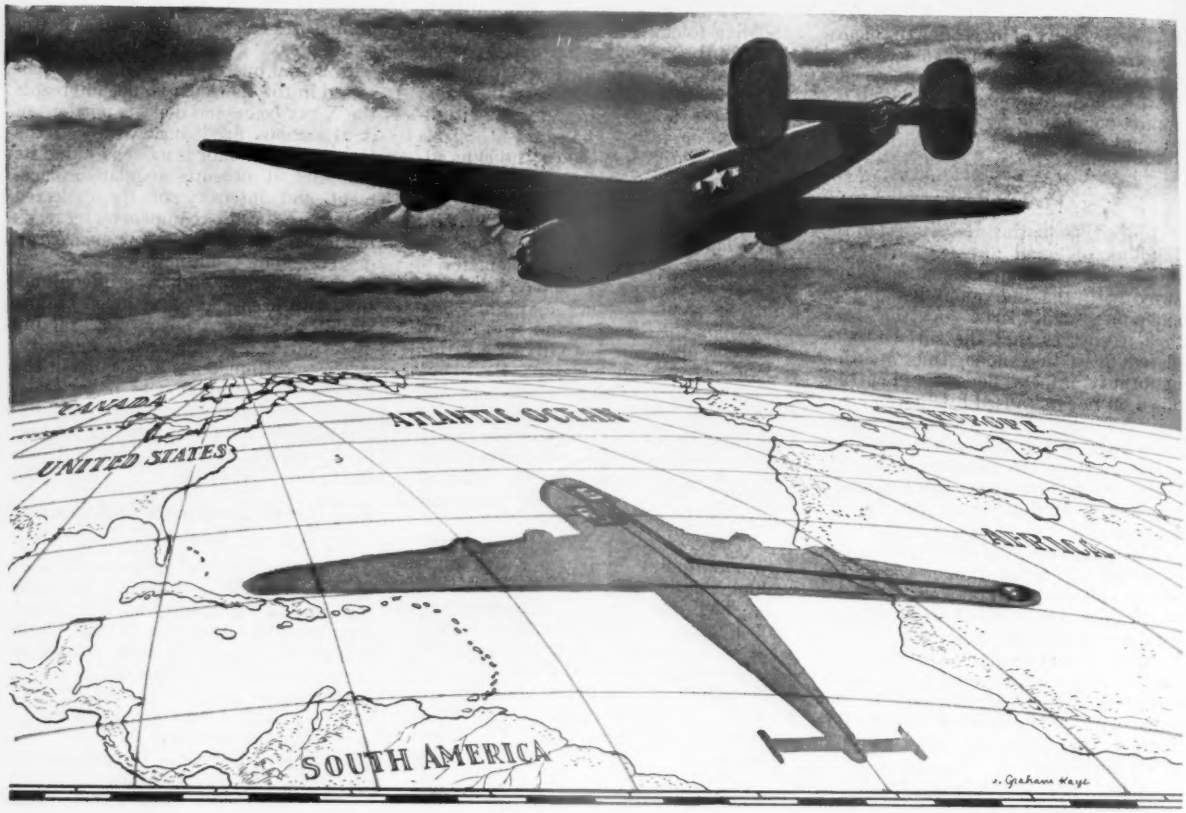
Roll Thread Comparator with Pressure Control

A new roll thread comparator with pressure control is based on the same principle of "go" and "no go" thread rolls used in Pratt & Whitney roll thread snap gauges for many years, but now this principle is combined with a dial indicator pressure control on both sets of rolls that provides for close-tolerance thread inspection.

When close-tolerance threads are being checked by inexperienced or "heavy handed" inspectors using standard roll thread snap gauges, the parts could be snapped through both sets of rolls and rejected when they actually are correct. It is for this sort of inspection that the pressure-control model was developed. As the work passes between the "go" rolls, any movement of the indicator pointer means an oversize thread. On the other hand, the pointer must move as the work makes contact with the "no go" rolls if the thread is correct. Lack of movement at the "no go" rolls means undersized work. All "feel" or judgment by the operator is eliminated.

The comparator consists of a rigid base casting and main frame that carries the indicator bracket. The frame

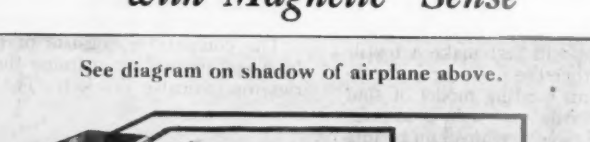
The new roll thread comparator of The Pratt & Whitney Division of Niles-Bemont-Pond Company.



Sperry Gyrosyn Compass

The Directional Gyro with Magnetic "Sense"

See diagram on shadow of airplane above.



G — GYROSYN COMPASS — installed on pilot's instrument panel or at navigator's station.

R — REPEATER—for remote indication. Up to six may be used.

F — FLUX VALVE—mounted in wing tip. Weighs 20 ounces.

Accurate! Reliable! Light Weight! Low Maintenance!

THE Sperry GYROSYN Compass is a directional gyro *synchronized* with the earth's magnetic field.

It combines the functions of both a Directional Gyro and a Magnetic Compass... deadbeat indication, accurate magnetic headings . . . without northerly turning error or resetting.

The GYROSYN Compass is an electrically driven directional gyro precisely controlled by a Flux Valve to indicate magnetic heading directly or through Repeaters.

The Flux Valve is a device for detecting the direction of the earth's magnetic field. Its design provides light weight, hermetic sealing, and small size for rigid mounting in the wing tip. It has no rotating parts.

The GYROSYN Compass weighs only 10 pounds including one Repeater. Provision is made for additional repeaters and for furnishing azimuth stabilization required by any other equipment.

Sperry Gyroscope Company INC.

GREAT NECK, NEW YORK • DIVISION OF THE SPERRY CORPORATION

GYROSCOPICS • ELECTRONICS • AUTOMATIC COMPUTATION • SERVO-MECHANISMS

carrying the upper pair of rolls makes contact with the indicator and is supported by reeds that provide for a vertical motion. The lower pair of rolls is supported in a frame that is adjustable on its slide but locks solidly in the desired position. A vertical adjustable screw stop holds the two roll frames apart at exact setting with the indicator at zero.

The gauge is adjustable over a range from 1/4- to 1 1/2-in. diameter and uses a gauging pressure of approximately 2 lbs. The indicator graduations are 0.0001 in.; this allows the gauge to be used for classifying if desired. The gauge stands 12 1/2 in. high and weighs approximately 16 lbs. Thread rolls of any desired pitch are available, as well as "go" and "no go" setting plugs for any given thread. Pratt & Whitney Division, Niles-Bement-Pond Company, West Hartford, Conn.

Postwar Amphibian

Republic Aviation Corporation plans production of a land and water plane for civilian use. Still in the development stage, the new plane is tentatively called the "Thunderbolt Amphibian." It is a high-wing monoplane of all-metal construction except for its fabric-covered movable control surfaces. The cabin of this plane accommodates four passengers, and its interior is designed with modern fittings. Wide vision is afforded by the upper half of the cabin, which is made mainly of Plexiglas.

The full cantilever wing of the amphibian has single-strut-supported wing floats. Its hull permits easy landing or take-off from water, requiring only 17 in. of draft when fully loaded. Wheels are retractable. Vacuum-operated slotted flaps are designed to insure safe landings at approximately 50 m.p.h. Power is provided by a single six-cylinder, horizontally opposed, 175-hp. engine. The location of engine and propeller in back of the cabin is a feature intended to assure greater safety in landing and docking. It also gives protection to the power plant from water spray and affords greater passenger comfort because of reduced noise and better forward vision. The clipper-type tail is said to add to the aerodynamic design of the plane.

Preliminary specifications are given as follows: gross weight, 2,600 lbs.; maximum speed, 120 m.p.h.; cruising speed, 105 m.p.h.; wing span, 36 ft.; length, 26 ft. 6 in.; height (on wheels), 8 ft. 7 in.; range, 5 hours. Republic Aviation Corporation.

Portable Bilge and Refueling Unit

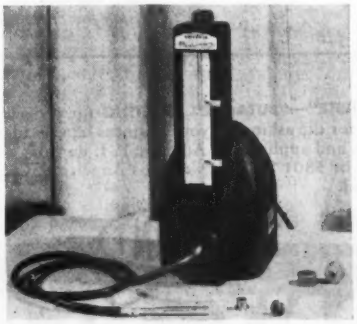
The Romec Model RG-4635-B is a two-purpose pumping unit built for refueling of aircraft at remote fuel caches or for the removal of bilge water from the hull and pontoons of seaplanes. The electric-driven unit comprises two nonpulsating, positive-displacement rotary pumps (fuel pump RD-4620 and bilge pump RD-6510), both with offset rotor, sliding blades, rocker seals, and motor. The drive end of the motor is equipped with an adaptor gearing for

The Romec bilge and refueling pumping unit.

both pumps by which they are selectively driven, one pump being engaged and the other disengaged simultaneously by a hand-operated shift lever. The bilge pump has a capacity of 840 gal. per hour; the refueling pump, 1,500 gal. per hour. Equipped with a 10-ft. suction hose and a 30-ft. fueling hose, the weight of the unit as stowed away is 64 lbs. Romec Pump Company, Elyria, Ohio.

Light-Wave Device for Measuring Parallelism

A new instrument is designed for measuring the parallelism of seal rings and similar objects and for determining the change of parallelism under any desired pressure. Sold under the trade name Acme Light-Wave Parascope, the instrument may also be used for measuring the comparative heights of objects that must have a tolerance within a few millionths of an inch.



This Sheffield Precisionaire instrument is used for rapidly checking critical internal dimensions having a tolerance of plus or minus five-millionths of an inch.

To measure parallelism, the work is laid on an optical flat with another optical flat placed on top. The entire assembly is then set on the table of the instrument. Looking into the eyepiece of the instrument the operator will see a number of bright and dark bands. Each dark or light band indicates a change of separation of the optical flat surfaces of approximately ten-millionths of an inch. The operator need only count the number of dark or light bands and multiply by 10 to determine the out-of-parallelism in millionths.

The manufacturer states that this new instrument can be used for making the usual light-wave check for flatness. In this procedure, the bands that appear will be straight if the surface is flat or curved to show any deviations from flatness.

The instrument will measure work up to 6 in. in diameter and 1/2 in. thick. It is built complete with light source and transformer for operation on 110–120 volt, 60 cycle a.c. Scientific Division, Acme Industrial Company, Chicago.

High-Amplification Measuring Instrument

Model No. 600-0 high-amplification Precisionaire provides an amplification of 20,000 to 25,000 to 1 (a spread of 2 to 2 1/2 in. per 0.0001 in.) on internal measuring. It is graduated in increments of five-millionths of an inch. This instrument is reported to have proved accurate in the rapid checking of internal dimensions on fuel-injection equipment having a tolerance of plus or minus five-millionths of an inch.

The instrument is suitable for tolerances ranging from 0.0002 to 0.000005 in. with amplification from 15,000 to 25,000, depending on the part to be checked (a spread of 1 1/2 to 2 1/2 in. per 0.0001 in.). Action of the floating indicator is stated to be as quick and stable as that of lower magnification models. The base instrument has the same general appearance as former Precisionaires but has been modified with specially built high-precision metering components. The Sheffield Corporation, Dayton, Ohio.

Device for Checking Threaded Parts

The Sheffield Thredchek is similar to a thread roll snap gauge and has a standard balanced-type large indicator graduated in 0.0001 in. mounted on it. The instrument employs the same "go" and "no go" rolls. However, the top "no go" roll is not fixed, and its movement is registered on the indicator showing the pitch diameter. A free rotating backstop enables the part to be properly located when presented to the "no go" rolls. This feature eliminates the possibility of "cocking." Since no trained sense of "feel" is needed in making the "no go" check, the human element of error is avoided.

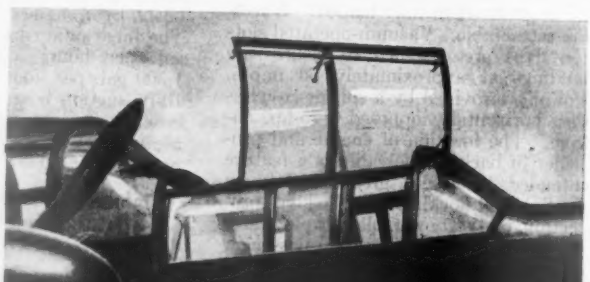
How the "Black Widow" uses "LUCITE"

CRYSTAL-CLEAR *transparency* without distortion and excellent optical qualities are of utmost importance in the pilot housing and tail gunner compartment of a pursuit ship like the Northrop Black Widow. That's why Du Pont "Lucite" methyl methacrylate resin sheets are used for enclosures on this fast-flying, hard-hitting interceptor.

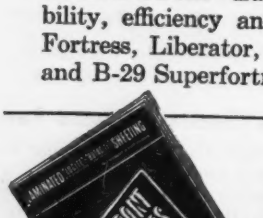
Colorless, transparent "Lucite" airplane sheeting surpasses Government specifications for optical uniformity—providing clear visibility. In addition, it has good shatter-resistance, high tensile and flexural strength, is light in weight and is not affected by the elements and by temperature changes.

Representative of other types of planes on which Du Pont "Lucite" has proved its adaptability, efficiency and economy are the Flying Fortress, Liberator, Lightning, Mustang, Mars and B-29 Superfortress.

Tail compartment *of "Lucite" on the Northrop Black Widow. From this vantage point radio operator-gunner can ward off attack from above and below.*



Pilot housing *of "Lucite" provides clear side, top and forward vision for crew members of Northrop Black Widow.*



LAMINATED "LUCITE"—"BUTACITE" SHEETING for pressurized plane enclosures. Free 28-page "progress report" is yours for the asking on your business letterhead. Provides technical information on proof tests, property graphs, and application. Address: E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J. or 5801 S. Broadway, Los Angeles 3, California. In Canada: Canadian Industries, Ltd., Box 10, Montreal.

DU PONT

DU PONT PLASTICS

BETTER THINGS FOR BETTER LIVING... *THROUGH CHEMISTRY*

If a part passes the "go" rolls, the lead, thread angle, and pitch diameter are shown to be within maximum tolerance limits, and the part will assemble. The indication of the pitch diameter when the part is presented to the "no go" rolls separates the check of pitch diameter from the check of the lead. If the pitch diameter is correct then it is known that the lead is correct. Correctness of form or angle can be checked visually as the work is passed through the full-thread form ribs of the "go" roll. When the part is rotated in contact with the "no go" rolls, the indicator shows any out-of-round condition.

The instrument can be placed in the standard thread roll snap stand and used at the bench for fast, accurate checking of production parts. It provides a convenient hand gauge for checking threaded work at or in the machine to make sure that the proper thread is being produced. Also, it may become an accessory to the visual gauge. The manufacturer states that full manufacturing tolerances can be utilized in production when the work is checked with this instrument. No allowance for wear is necessary, since this is compensated for by adjusting the rolls on their eccentric pins. The Sheffield Corporation, Dayton, Ohio.

Handley Page "Hermes"

Design and performance details are now released on a new British air liner, the Handley Page Hermes, which has been developed for trunk air-route operations. Two versions of the Hermes are scheduled for construction. One will be a passenger airplane, with varying accommodation for day or night sleeper travel over stages up to 2,000 miles point-to-point. The other will be a commercial cargo version, outwardly the same aircraft but internally adapted to carry up to 16,000 lbs. of freight, compared with its total weight of 70,000 lbs. The passenger version includes a fuselage that has a "pressurized" cabin. The cargo version, not equipped with pressure cabin, has a large door to permit ingress of bulky goods.

The Hermes is of conventional low-wing, all-metal stressed-skin design and construction. Its most noticeable features are the circular cross section of the fuselage which tapers to a conical tail. Power is provided by four Bristol Hercules 14-cylinder sleeve-valve, radial air-cooled engines, giving a total maximum output of 6,600 hp. Each engine drives a de Havilland hydromatic, full-feathering propeller. Both main forward undercarriage and tail wheel are retractable. The Hermes is reported to be scheduled for a maximum speed of 340 m.p.h., a weak-mixture maximum cruising speed of 289 m.p.h., and an economical cruising speed over long distances of 240 m.p.h.

Provisional layouts have been drawn up for four passenger versions. The first provides 34 seats for day travel. The second offers 32 day seats which, by a conversion system, can be altered to become 16 sleeper berths for night travel. The third, designed for shorter travel stages, has 50 passenger seats, and the fourth version is designed on deluxe Pullman-car lines with club-style accommodations for 20 passengers. Provision is made in all these versions for a crew of at least six, including two pilots, one flight engineer, a radio operator, navigator, and one or more stewards.

It is anticipated that the Hermes will be able to travel at heights up to 25,000 ft. Special heating is installed to maintain an internal temperature of 70°F. even when the external temperature is as low as −38°F. Wings, engines, propellers, and tail surfaces are equipped with deicing apparatus. Fuel tanks aggregating 2,750 gal. (English) of gasoline are grouped in the wings. These are expected to provide enough fuel for a range of 2,000 miles, even against strong head winds. Four compartments are available for the stowage of baggage, freight, or mail, and the loadings are distributed to spread the weight along the fuselage. The total space available amounts to 630 cu.ft. The Society of British Aircraft Constructors Ltd.

New Standard British Wiring System for Aircraft

A new system of electrical wiring has been developed by the Technical Board of the Society of British Aircraft Constructors Ltd. It consists essentially of a series of connector blocks with direct connection to the main power source (generator or battery). From the connector block extend simplified plug-in leads. The block is made of lightweight plastic material of high electrical efficiency and, so far, is available in two-, three-, five-, and 15-way units, either single- or double-tiered.

Using this Standard Wiring System, an aircraft designer can provide at one centralized point, or at any number of dispersed points, the requisite number of connector blocks with their varying numbers of leads. If, in course of time, it is found necessary to increase the number of leads, another connector block of the requisite capacity can be affixed. An idea of the compactness of the block is gained from the dimensions of the five-way pattern which is $2^1/_8$ in. wide, $1^1/_4$ in. high, and $1^3/_8$ in. deep. Clusters of these blocks can be grouped in a small overall area.

Formerly, maintenance mechanics were obliged to master the intricacies of individual electrical wiring systems for each different type of aircraft. The new system, which is standard for all new types of British aircraft, simplifies electrical maintenance work. For example, if a wing has to be detached and replaced by another, all that the electrician has to do is disconnect the leads from the connector block at the wing root and plug in the new wing's wiring at the same connector sockets.

Numerous other advantages are claimed. Wiring lengths and cables can be supplied ready made to measure, fitted at both ends with universal plug-in ferrules that have been specially designed as an S.B.A.C. aircraft standard. Wiring leads of the correct length can be made in the factory and there bonded together, assuring the correct sequence for plug-in and mating with the sockets in the connector block.

Condensation is checked by a special "honeycomb" wiring pattern for moisture drainage and ventilation. In aircraft that are brought into close contact with salt atmosphere, a special spray-proof enclosed cover houses the connector block. The first aircraft to incorporate the new system is a large new British civil air liner. The system will be adopted for all succeeding aircraft. It is covered by patents. The Society of British Aircraft Constructors Ltd.

Device for Training Bombardiers

Avoiding the limitations, risks, and expense of actual bombing instruction from planes in flight, the "7A-3 Horizontal Bombing and Dead Reckoning Trainer" can be used to give training in bombing, dead-reckoning navigation, intercommunication procedure, evasive action, and many other problems that the bombardier finds in actual combat flight. It can be stopped at any moment in order to permit further instruction or the analysis of errors and can be reset instantly for another "flight" of any desired kind.

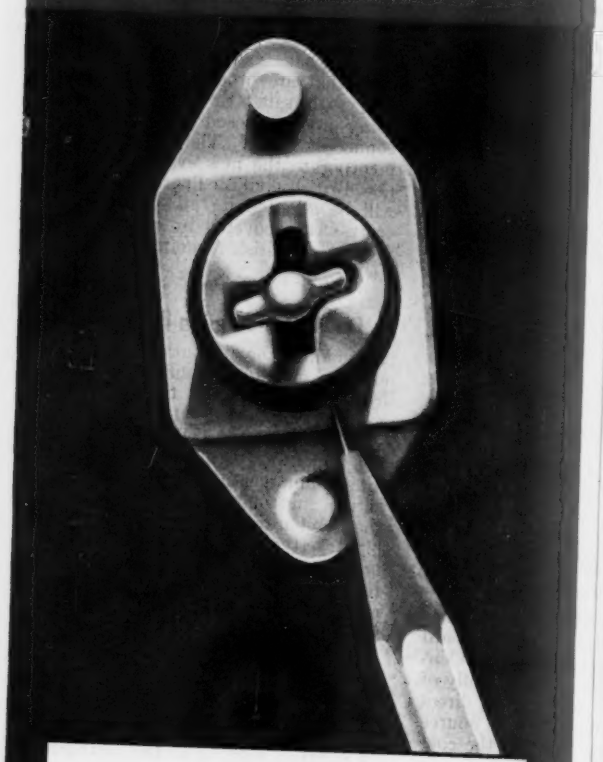
The trainer consists of a mock-up or reproduction of the bombardier's compartment in the four-engined bomber known in the Navy as the PB-4Y and in the Army as the Consolidated B-24. It is fitted with all of the instruments and controls, including a late-model bombsight, found in the real airplane. At a control desk just outside the mock-up, the instructor is provided with means not only for keeping track of the instrument settings made by the student but for setting up problems at any desired altitude, speed, and other characteristics.

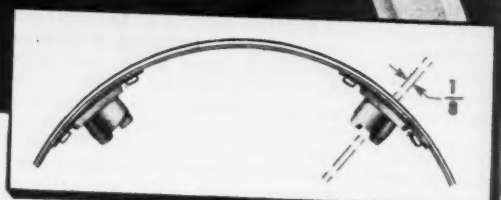
As the student crouches in the bombardier's position, an optical projector shows on the floor below him the image of an actual target area. The image moves in accordance with the altitude, speed, etc., set up for that particular problem. It also gives the effect of drift according to any desired cross wind. To complete the illusion of reality, mechanical devices reproduce both the noise and the vibration of the bomber's engines, and a refrigerating system produces below-freezing temperatures in the training room to accustom the student to working in heavy flying clothing.

The student identifies his target as it approaches and then makes his instrument settings and releases his bombs exactly as if he were on an actual bombing run. After the interval representing the falling of the bombs, the noise and vibration are cut off, all controls are "frozen," and a ring and spot of light is flashed onto the target to indicate the point at which the bombs theoretically landed.

The entire group of equipment is housed in a prefabricated darkroom en-

10 REASONS





No. 2 FREE FLOATING RECEPTACLE

Camloc's unique spring-in-stud design permits wide choice of receptacles resulting in extreme flexibility of application. Camloc's free floating receptacle is one of the most popular, since it allows up to 1/8" misalignment in any direction. Stud always enters receptacle at correct angle even on sharply curved installations. Jamming due to reverse thrust is impossible. You'll be interested in the other nine reasons, too. Ask about them.

CAMLOC

CAMLOC FASTENER CORP.
420 Lexington Avenue, New York 17
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QUICK-ACTING FASTENERS

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THE SUPERFORTRESS

An Aerodynamic Dream!

The sweep of great graceful wings . . . the shining silver surface of a streamlined fuselage . . . the throaty, throbbing rumble of four mighty engines . . . there's majesty in every line of the Superfortress . . . she's every inch a queen!

. . . KENYON had a part!

We at Kenyon, who were privileged to supply some of the high-precision parts for the Flying Forts, are proud that we were called on for a similar assignment in building the Superfortress. Fine precision work is a tradition at Kenyon — it started long before the war, and will continue when the war is won.

American airplane manufacturers from the beginning of the war have found Kenyon ready and able to supply precision parts. Kenyon engineers and laboratories were, and are, available for the solution of special problems — from wind-tunnel models to combat instruments. And Kenyon craftsmen have the skill and experience to make the parts and make them right — even if they have never been made before!

That's how Kenyon has become trouble-shooter to the aircraft industry — that's why we promise plane makers now and in the future, precision parts in quantity, on time.

KENYON

INSTRUMENT CO. INC.
HUNTINGTON, L. I., NEW YORK

If It's Kenyon-Made, It's Precision-Built

Do MORE for the War in '44 —
Buy MORE War Bonds

closure that may be erected out-of-doors or in aircraft hangars. Mechanical and electrical equipment in each unit is self-contained, and the device may be readily set up using a minimum of electrical and mechanical installation labor. The device was developed jointly by officers of the Special Devices Division of the Navy Bureau of Aeronautics and engineers of International Business Machines Corporation.

Hole-Punching System

The Wales "CD" Hole-Punching System consists of hole-punching units, templates, locator rings, adjustable stops, and feed rails. It is credited with reducing the making of perforating dies to a quick assembly operation. Dies may be made and put into operation more quickly than a "custom-made" die. In fact, it is often possible for a die to be put in operation the same day a pattern is released for production.

The hole-punching units consist of two parts, the punch assemblies and the die assemblies, which are independent and self-contained for quick mounting to templates and then to die sets, or for mounting directly to die sets. The punch assembly consists of a holder that holds the punch, stripping spring, and guide in exact relationship to the die assembly. The die unit consists of a ho'der with a built-in slug clearance chute, a die, and a pilot pin. The pilot pin in the punch assembly is part of the punch. The same group of units may be used and reused in an unlimited number of setups. This feature permits the investment in units to be kept in productive operation rather than in "dead-storage."

Setups are made outside the press and are ready to start punching on the first down-stroke of the ram. No adjusting or aligning is required by these units when mounted to templates or to die sets. The press ram requires only one adjustment regardless of the number of hole-punching patterns because of the uniform shut height of Type "CD" units. These advantages reduce press "down-time" between setups to a minimum. All parts of these units are interchangeable.

The two methods of mounting these units into a multiple hole-punching die are to templates and directly to die sets. The template-mounting method requires a pair of templates—one template for mounting the punch assemblies and one for mounting the die assemblies. Different pairs of template setups for punching various hole patterns may be bolted to the same die set, which permits the die set to remain in the press for all pattern runs. Mounting Type "CD" units directly to die sets is most advantageously used for unusually long runs. The same die set may be used for other pattern setups, providing the pilot and mounting holes do not fall in the same locations as previous patterns.

Both of these methods of mounting require the drilling of two mounting holes and one pilot hole for each die assembly and punch assembly. Each pair of tapped mounting holes is located by drill jigs from the pilot-pin hole. Drill jigs have built-in pilot pins for exact locating in relation to this pilot-pin hole. Locator rings are used with template mountings to line up the punch setup with the die setup. All rings remain in position until the template is securely bolted to the die set. After the rings are removed the entire perforating die is ready to operate with the first down-stroke of the press ram.

For quick, accurate locating of the work during feeding operations, work stops are available with adjustable gauge rods. These stops are clamped to the die holder. To eliminate sagging of the work, feed rails are available for bolting to templates in the same manner as die assemblies. They may be located wherever support is required by the work. The maker's catalogue *CD* describes the equipment. Wales-Strippit Corporation, North Tonawanda, N.Y.

Horizontal bombing and dead-reckoning trainer.

Test Coupling

The development of a "direct-connect" coupling specially adapted for use in testing operations is reported.

The direct-connect coupling fits over the end of any standard nipple, the "dogs" of the coupling gripping securely in the undercut just behind the threads on the nipple. It is equipped with a seal that is stated to have withstood pressures up to 3,000 lbs. As much as a 50 per cent saving in man-hours and labor is claimed, applicable for all testing operations. The coupling is made in sizes of $1/4$, $5/16$, $3/8$, $1/2$, $5/8$, and $3/4$ in. E. B. Wiggins Oil Tool Company, Inc., Los Angeles.

Visual Control Boards Facilitate Contract-Termination Procedures

The work of contract termination and adjustment has been facilitated by installation of a "visual-control board" system scheduling dates and steps in reconversion, while eliminating the former method of "ledger" control. In two instances involving recent terminations or conversions, the plant has arranged schedules for $128,000,000 and $50,000,000 terminations in 105 days and 90 days, respectively.

The new visual-control method, known as Produc-Trol, was reported to be approximately four times as fast as other methods. One large company recently reported handling a $217,000,000 termination within a period of 2 years, in contrast to the 150-day schedule compiled by Wright Aeronautical Corporation.

The nucleus of the system, which is available to all manufacturers upon request, lies in the use of visual-control boards of the kind widely employed in scheduling production. The system includes the regular procedures of handling nearly 1,000 vendors and about 15,000 purchase orders at one time. Its speed and efficiency, however, rest in the method of scheduling the various steps involved in a termination, keeping track of the progress made from day to day, and giving an overall picture at any given moment.

By the former method of employing forms and ledgers, the handling of vendors was a critical problem failing mainly in giving a clear overall picture. While revisions were posted in the ledgers, changes in the status of dealings with half a dozen vendors might take place so that the revised posting was obsolete even before it was finished. Constant rechecking and possible overlooking of some vendors was the inevitable result of the former method, it was claimed. The following are steps in the new visual-control system:

When contract termination notice is received, a schedule is established after conferences with officials of the affected departments. It indicates the date when each of seven major steps of the termination procedure should be completed. Each operation is represented on the control boards by a different colored vertical line, the lines superimposed on the exact date when the operation is scheduled for completion.

Each horizontal line represents a canceled purchase order resulting from the termination, and progress through each step of the procedure is plotted as the action takes place. Postings are made by inserting a peg of the same color as the corresponding vertical line on the actual date when the operation was accomplished. The white horizontal progress line is then extended to meet the colored vertical line representing that step in the procedure.

The outstanding vertical line on the board is the current date line, which is moved one space toward the final goal each day. As it approaches the vertical schedule line it is possible to plan the next action. As the date line meets the various schedule lines, it can be seen at a glance, by comparison with the horizontal progress lines, exactly which vendor cancellations run behind schedule. Effort is directed toward keeping the progress lines up to, or ahead of, the moving date line at all times. Wright Aeronautical Corporation.

Sealing the Doom of Nippon!

Plans for the total defeat of Japan called for a bigger bombing plane than any previously conceived. We have it now, and it has already proved itself — the Boeing B-29 Superfortress.

Carrying a heavier bomb load, having greater horsepower, longer range and higher speed than any bomber made, and with a firepower that defies enemy attack, the Superfortress has already visited destruction on many vital Japanese production centers. But the Nips haven't seen anything yet. American quantity production of Superfortresses seals their doom. Six great aircraft plants and hundreds of sub-contractors are concentrating on the greatest manufacturing program ever put behind a single implement of war.

Of course, such a plane must be super-staunch in every construction detail. We are proud of our contribution in the form of steel at its ultimate strength — *tough drop forgings* — for parts which must withstand the terrific tensional, torsional and compression stresses involved.

Devoted entirely to the production of airframe drop forgings, we invite the inquiries of plane and engine builders requiring improved production facility.

Member of the A.C.C.A.

ARMY ★★ NAVY

Kropp Forge Aviation Co.

5301 W. ROOSEVELT ROAD CHICAGO

Engineering Representatives in Principal Cities

Institute News

The Thurman H. Bane Award for 1944

Col. Donald J. Keirn of the Power Plant Laboratory, Wright Field, Dayton, Ohio, was given The Thurman H. Bane Award for 1944, for "His contribution to the development and utilization of the new jet propulsion engine." The presentation of the award to Colonel Keirn was made by Lt. Gen. William S. Knudsen, Director of the Air Technical Service Command, at a special meeting prior to the evening session of the Fall Meeting on Thursday, November 9, 1944. Lieutenant General Knudsen referred to Major Fleet's generosity in establishing the award and said that its presentation to Colonel Keirn was well deserved and reflected credit on the engineering work done by the Air Technical Service Command.

The members of the Committee making the award were: Hon. Robert A. Lovett, Assistant Secretary of War for Air; Gen. H. H. Arnold, Commanding General U.S. Army Air Forces; Dr. Lyman J. Briggs, Director, National Bureau of Standards; and Major R. H. Fleet, President of the Institute of the Aeronautical Sciences.

Given annually for the most important technical achievement by an officer or a civilian of the Air Technical Service Command, Wright Field, Ohio, the award was established by Major R. H. Fleet in the latter part of 1942. The initial presentation was made to Col. H. F. Gregory for his contribution to the development of the helicopter.

In accepting the award Colonel Keirn said:

"Mr. Chairman, Gen. Knudsen, Gentlemen: There have been three proud moments in my life, when I received my diploma at West Point, when I received my wings, and this moment to receive this award for a contribution in the field of aeronautics.

"The Thurman H. Bane Award, given in memory of the first chief of the Engineering Division at McCook Field, was undoubtedly inspired to keep before us the work of a man who laid some of the foundation for future developments in military aeronautics. Those of us who have been so closely associated with the development and utilization of the jet propulsion engine for aircraft, sincerely hope that our work will serve a useful purpose in the future developments in aviation.

"In accepting this great honor, my mind turns to many individuals and organizations whose cooperative efforts have made this development possible. To Group Capt. Frank Whittle and his associates who built the first jet propulsion gas turbine, to the British Ministry of Aircraft Production for their encouragement of the development, to Gen. H. H. Arnold, Chief of the Army Air Forces, who recognized the potentialities of this development, and initiated the negotiations which ultimately resulted in the close cooperation and exchange of information between the United Kingdom and our Country; to the General Electric Company; to the Bell Aircraft Company and others for their cooperation with our Government in undertaking a development so extensive and revolutionary in scope. Not the least of these contributions have come from the members of the staff, both officers and civilians, of the Air Technical Service Command at Wright Field.

"The various jet propulsion projects being undertaken for the Army Air Forces are classified, and it is impossible for me to discuss them in detail. I should like, however, to say a few words of a more general nature.

"I feel that the real significance of the development is not the propulsion of aircraft by a jet. It appears much more significant that this development introduces the gas turbine into the aircraft propulsion field; it marks the first phase in the development of a new type of aircraft power plant.

"The future of the aircraft gas turbine is as much your guess as mine. If history is a key to future events, a parallel might be drawn in the gradual replacement of reciprocating steam engines by the steam turbine for ship propulsion. It is sufficient to say now that we are at the threshold of a new field of aircraft propulsion which greatly extends our vision with regard to future aircraft performance.

"I accept this award as a representative for the many people whose ingenuity and skill have brought the jet propulsion gas turbine to its present state of usefulness. We pledge our continued efforts in its further development and utilization to the end that it may be a factor in continuing the air supremacy of our Air Forces, and we hope and believe that this development will find a peacetime utility as great as that of war."

Gen. H. H. Arnold, Commanding General of the Army Air Forces, sent a

Col. Donald J. Keirn (*center*) with Lt. Gen. William S. Knudsen and Lester D. Gardner, following the presentation to Colonel Keirn of The Thurman H. Bane Award.

Big as a bomber, fast as a fighter . . . the first U. S. warplane ever designed especially for night fighting

NORTHROP BLACK WIDOW P-61 NIGHT FIGHTER

NORTHROP AIRCRAFT, INC.
NORTHROP FIELD, HAWTHORNE, CALIFORNIA
MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

This revolutionary new fighter has a "combat urgency" designation. Our Army has now increased by 30% its original order for the Northrop Black Widow . . . the P-61 Night Fighter.

This deadly fighter stalks and finds enemy planes in pitch darkness as no other airplane can. It packs enough 20 millimeter cannons and .50 caliber guns to blast apart anything that flies.

Big as it is, the Black Widow is fast as smaller fighters. Yet it can literally hover in the sky when need be. It takes off quickly, climbs sharply, and has a very slow landing speed for additional safety.

It's powered by twin 2000 horsepower engines. It has plenty of room for its fighting crew of two or three specialists—and long-range fuel tanks.

The remarkable Black Widow is Northrop designed and produced. Into it has gone the far-reaching Northrop know-how in aerodynamic development. Through the war and in the peace ahead, Northrop's proven talents will continue to serve America.

THE THURMAN H. BANE AWARD

PRESENTED BY THE

INSTITUTE OF THE AERONAUTICAL SCIENCES

TO AN OFFICER OR CIVILIAN OF THE ARMY AIR FORCES AIR TECHNICAL SERVICE COMMAND FOR AN OUTSTANDING ACHIEVEMENT IN AERONAUTICAL DEVELOPMENT DURING

1944

THE COMMITTEE OF AWARD HAS CHOSEN

DONALD J. KEIRN

FOR

HIS CONTRIBUTION TO THE DEVELOPMENT AND UTILIZATION OF THE JET PROPULSION ENGINE

COMMITTEE OF AWARD

H. H. Arnold
COMMANDING GENERAL ARMY AIR FORCES

Robert A. Lovett
ASSISTANT SECRETARY OF WAR FOR AIR WAR DEPARTMENT

Lyman J. Briggs
DIRECTOR NATIONAL BUREAU OF STANDARDS

L. H. Adams
PRESIDENT INSTITUTE OF THE AERONAUTICAL SCIENCES

congratulatory telegram to Colonel Keirn as follows: "Please extend to Colonel Keirn my congratulations on his being presented The Thurman H. Bane Award for 1944. His outstanding work in the development of a successful jet propulsion engine is a real contribution to the advancement of aviation."

The General Electric Company also congratulated Colonel Keirn in a message which said: "The General Electric Company joins with Colonel Keirn's associates in offering sincere congratulations on the occasion of the presentation of the Bane Award. We are fully aware of the work that Colonel Keirn has done on gas turbines and of the contributions he has made. We deeply appreciate his assistance and cooperation and we know well that he fully deserves this award. Our best wishes go to Don Keirn for continued success."

Officers from Wright Field, associates of Colonel Keirn, and members of the Institute joined in a dinner in honor of Colonel Keirn before the presentation of the award. Those present at the dinner were: Lt. Gen. William S. Knudsen, Orville Wright, Brig. Gen. F. O. Carroll, Lester D. Gardner, Col. J. M. Gillespie, Carl I. Friedlander, Col. Marshall S. Roth, A. Bennett, Col. Donald L. Putt, Bradley Jones, Col. Bryant L. Boatner, F. T. Harrington, C. J. Brukner, Col. H. Z. Bogert, John K. Northrop, Col. Paul Nay, John R. Weske, Col. R. L. Wassell, Charles S. J. Mac Neil, Jr., Col. J. M. Hayward, A. Francis Arcier, Lt. Col. C. Terhune, John Allwood, Russell F. Rogers, Major E. Kotcher, Richard M. Mock, Major S. P. Voorhees, Bennett H. Horchler, Major L. D. Mitchell, George R. Forman, Lt. Edward Woll, Robert R. Dexter, Lt. Robert G. Bartlett, and H. Yale Mageoch.

Information about the jet propulsion engine, which will power fighter aircraft of greater speeds than possible with airplanes of the conventional type, was first made public during the current year. It was originally built and flown in Great Britain. Colonel Keirn, Power Plant Laboratory, Air Technical Service Command, was appointed by the Commanding General, Army Air Forces, in 1941 to go to England to analyze its design, to study the possibility of its adaptation to military aircraft, to return and develop a source of supply, and ultimately to serve as director and consultant to those taking part in the further development of this type of power plant. The work was considered of tremendous importance because of the great promise it held of future increases in the performance characteristics of aircraft.

In 1943, as a result of intensive effort, outstanding ability and leadership on the part of Colonel Keirn, and the excellent cooperation of the General Electric Company and the British Ministry of Aircraft Production, a new jet propulsion engine was built and successfully flown.

Colonel Keirn is one of the select group of flying-engineers of the Army Air Forces who have proved their value in development of the air equipment that is winning the present war. A native of Colorado, he attended Denver schools and the Colorado School of Mines. He is a graduate of the U.S. Military Academy (1929) and the Air Corps Engineering School (1937) and holds a master of science degree in Aeronautical Engineering (1938) from the University of Michigan. He has been stationed at Wright Field since 1936.

Gifts to the Aeronautical Archives

The Misses Elizabeth and Octavia Chanute gave the medal presented to Octave Chanute in 1910 for his distinguished services to aeronautical science by the Aeronautical Society of Great Britain; the Octave Chanute Medal, presented to Chanute in 1909 by the Western Society of Engineers; the E. J. Marey medallion; the L. P. Cailletet medallion; a medal commemorating the "liquefaction de gaz"; and the Aero Club of America medal presented to the Wright brothers in 1905. The Misses Chanute also gave five aeronautical pamphlets published before 1910 and clippings collected by their father.

The officers of the Institute are particularly pleased to have the Gold Medal of The Royal Aeronautical Society in its collection. On the edge of the medal the following inscription is engraved: "To Octave Chanute in recognition of his distinguished services to aeronautical science, 1910."

The Institute greatly appreciates the generosity of the Misses Chanute in placing these rare and highly personal gifts in the collections of the Archives.

Comdr. Harry F. Guggenheim and the Guggenheim family gave the Spirit of St. Louis Medal, presented to Daniel Guggenheim in 1929 by the American Society of Mechanical Engineers, for meritorious service in the advancement

Through the war and in the peace ahead, Northrop's proven talents will continue to serve America.
fighters. Yet it can literally hover in the sky when

STAINLESS guards these "hot spots" in the B-29

A Fwd. Collector Shroud
B Nose Ring
C Fwd. Tail Pipe Shroud
D Exhaust Collector
E Flight Hood
F Longeron
G Waste Gate Exhaust Pipe
H Inner Cowl
I Nacelle Shroud
J Slide Panel

Like all American warplanes, Boeing's super-battleship of the air is well equipped with stainless steel parts. This rustless metal is used wherever great strength and prolonged heat resistance are vital to efficiency and safety.

Some parts made of ARMCO Stainless Steels are indicated in this close-up view of the B-29. The four great housings of the Superfortresses' 2200-hp. engines embody stainless steel, selected for its strength and resistance to intense heat generated by the mighty power plants.

Other parts, like the collector systems, must "take it" too. In endless hours of combat flying, red-hot corrosive gases blast their way through exhaust collectors. And vibration puts stainless to a severe test. Yet this heat-resisting metal comes through unscathed in flight after flight.

You'll approve these other advantages of ARMCO Stainless Steels too: They form easily and can be fabricated by the fast spot-welding process. The strength-weight ratio is exceptionally high.

If you want qualities like these in your future products, consider using ARMCO Stainless. There is a grade for every requirement. For complete information just address The American Rolling Mill Company, 3561 Curtis Street, Middletown, Ohio.

EXPORT: THE ARMCO INTERNATIONAL CORPORATION

The American Rolling Mill Company

MADE OF ★ ARMCO ★ STAINLESS STEEL

Gold medal given to Octave Chanute in 1910 by the Aeronautical Society of Great Britain (now The Royal Aeronautical Society). Presented to the Institute by his daughters.

of aeronautics. The gift included the original gold medal and a replica in bronze. This is another instance of a family entrusting to the Archives a medal having personal associations.

Lt. Col. Eric Wood gave a piece of a Japanese twin-engined bomber shot down over Pelelieu Island in 1944.

A bound scrapbook of clippings from the *New York Herald Tribune*, on the career of Charles A. Lindbergh from May, 1927, to the early part of 1928, was received from Max Rockman, who compiled the scrapbook. It contains more than 1,500 clippings of news and feature stories, editorials, cartoons, rotogravure and news pictures, and advertisements using Lindbergh themes.

Three original aeronautical drawings were received from Rollin Kirby through the courtesy of the Museum of the City of New York. A pair of binoculars was received from the Kollsman Instrument Division of the Square D Company through the courtesy of Victor E. Carbonara. Mrs. Bella C. Landauer gave a handkerchief commemorating the Exposition Universelle, Paris, 1900.

Nineteen insignia of the Royal Norwegian Air Force were received from the Royal Norwegian Air Force Training Center. Twenty-nine British Fleet Air Arm insignia were received from Geoffrey Smith. A lapel wings of the East New York Vocational High School was sent by Austin O. Huhm. The Hamilton Standard Propellers Division of the United Aircraft Corporation gave a colored print of the Douglas Skymaster transport airplane. The Republic Aviation Corporation gave four colored lithographs of the P-47 Thunderbolt fighter airplane.

The British Air Commission in Washington added thirteen *R.T.P. Translations* to the large number previously given. The Glendale Rocket Society sent issues of its *Bulletin*. General Ludendorff's *Meine Kriegserinnerungen, 1914–1918*, was received from Eugene Moritz.

Additional gifts were received from the Goodyear Tire & Rubber Company, Manchester Bank of St. Louis, Legation of the Union of South Africa, U.S. Office of War Information, Senate and House document rooms, Wright Field Techical Library and the War Department Bureau, of Public Relations.

Daniel Guggenheim Medal for 1944 Awarded to Lawrence D. Bell

The Daniel Guggenheim Medal for achievement in aeronautics has been awarded to Lawrence D. Bell for "achievement in design and construction of military aircraft and for outstanding contributions to the methods of production." Mr. Bell is an Industrial Member of the Institute.

Mr. Bell is one of the aeronautical pioneers still actively engaged in the industry. He is widely known for his Airacuda, Airacobra, and Kingcobra fighter planes, which have held such important places in the United Nations' air leadership in the present war. It is not so generally known by the public that he is also an important producer of the Boeing B-29 Superfortress. The breadth of his interests includes rocket planes and helicopters.

His intense interest in aviation took him, at the age of 17, into The Glenn L. Martin Company, where a year later he was shop foreman, quickly rising to Vice-President and General Manager. After 16 years in that connection, he became Vice-President and General Manager of the Consolidated Aircraft Corporation. Seven years later he organized his own company, specializing in fighter planes. He served as President of the Aircraft War Production Council, East Coast, and of the National Aircraft War Production Council and achieved recognition in business through his place on boards of directors in various companies.

Lawrence D. Bell

The Daniel Guggenheim Medal was established in 1928 "for notable achievement in the advancement of aeronautics." The award is made by a committee appointed by the American Society of Mechanical Engineers, Society of Automotive Engineers, and the Institute of the Aeronautical Sciences, together with past medalists residing in the United States. Past medalists have included Orville Wright, William E. Boeing, Donald W. Douglas, Glenn L. Martin, and Lt. Gen. James H. Doolittle.

Sections and Branches

San Diego Section

The annual business meeting of the San Diego Section was held on September 22 at the Chamber of Commerce board room, with about 40 members in attendance. In the absence of E. G. Stout, Joel N. Whitney, the acting chairman, presided. The following list of new officers was announced: Chairman, Joel N. Whitney; Vice-Chairman, Jack Mason; Treasurer, Franz J. Schnaubelt; Corresponding Secretary, C. L. Blake; Recording Secretary, F. L. Thornburg.

Following a summary of the preceding year's meetings and business activities and the presentation of the report of the Treasurer, slides were shown giving a pictorial view and a floor plan of the proposed Institute building for the San Diego Section.

The meeting was concluded by the showing of a film depicting the organization and disposition of the Army Air Forces.

University of Kansas

At the first meeting of the fall term held on August 31, officers were elected and three motion pictures were shown. These were: *Manganese—Metal from the Sea, Airplane—Metals, Fuels, and Lubricants*, and *Lockheed P-38*.

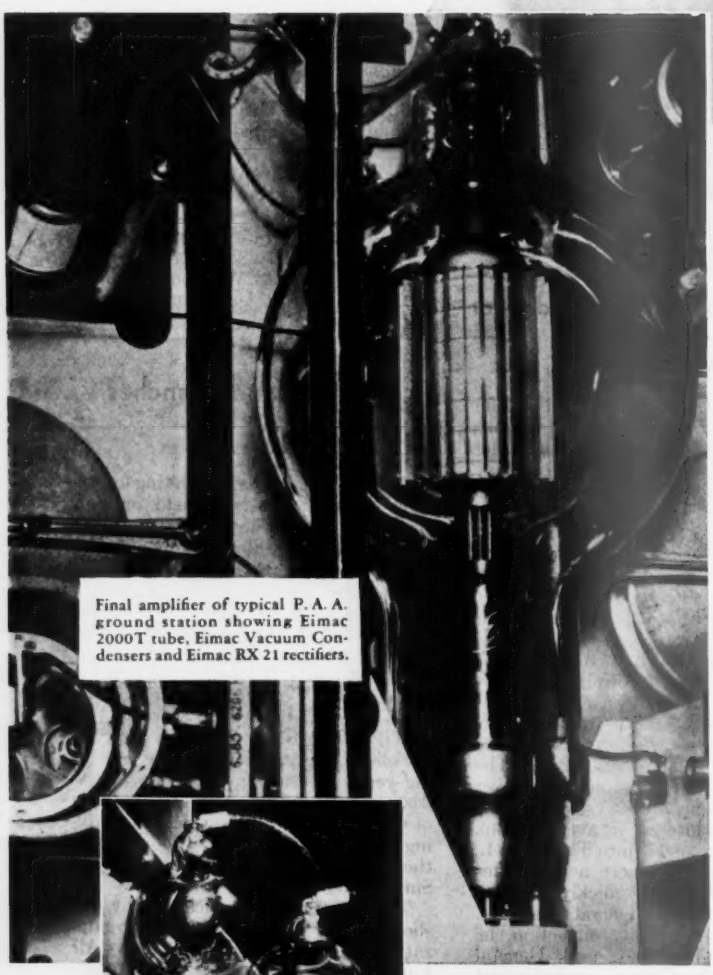
At a meeting on September 28 a lecture was given by Asst. Prof. Robert W. McCloy on the subject of "Rockets."

On October 12 a motion picture *Construction of a Light Airplane* was shown.

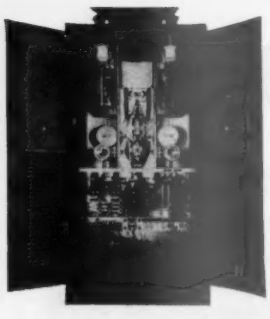
Massachusetts Institute of Technology

A regular business meeting was held on October 18 at which the following officers were elected: Chairman, Kirk Drumheller, Vice-Chairman, Sheridan Ing; Secretary-Treasurer, Robert D. Luce; Program Chairman, Robert E. Wilson. The new officers will serve

PAA PAN AMERICAN USES EIMAC TUBES



Final amplifier of typical P. A. A. ground station showing Eimac 2000T tube, Eimac Vacuum Condensers and Eimac RX 21 rectifiers.



Pan American World Airways, which has done so much to advance the war-time goals of the nation, has just announced a plan for a new service to South America. Employing a fleet of stratosphere planes, carrying 108 passengers, flying at more than three hundred miles an hour, Pan American proposes to take travelers from New York to Rio de Janiero in less than twenty hours instead of the present sixty-six hours, charging $175 for the trip, as against the current rate of $491.

Pan American Airways and all its associated and affiliated companies, which comprise the P. A. A. World System, have been using Eimac tubes in the key sockets of all ground stations for a number of years.

Because of the extensive operations of Pan American World Airways, these tubes have been subjected to about every test possible — altitudes; ground level; extremely cold climates and high temperatures found at the equator; conditions of high and low humidity; and in some instances, when new bases are being built, perhaps somewhat trying power conditions. The high regard which P. A. A. engineers have for Eimac tubes is clearly evidenced by their continued and more extensive use, as the years roll by.

The fact that Eimac tubes are the number one favorite of the commercial airlines is important evidence to substantiate the oft repeated statement that "Eimac tubes are first choice of leading electronic engineers throughout the world."

Follow the leaders to

Eimac REG. U. S. PAT. OFF. TUBES

Write for your copy of Electronic Telesis—a 64 page booklet fully illustrated—covering fundamentals of Electronics and many of its important applications. Written in layman's language.

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during the school year that started on November 6.

Efforts have been made during the past summer to provide several addresses by British aeronautical engineers, but it was found impossible to complete the necessary arrangements, with the result that special meetings were omitted during the summer term.

University of Texas

The University of Texas Student Branch held a regular meeting on October 3. A film titled *Aircraft Fuels and Metals* was shown.

The meeting on October 18 was open to the public. John Densenig, Jr., Field Representative of Jack & Heintz, Inc., spoke on the topic "Gyroscopic Instruments and Electrical Accessories for Aircraft." The discussion included gyroscopic theory, the use of gyroscopic instruments and safety devices, air-driven and electric gyroscopes, and other accessories. Cutaway models were used in connection with the lecture.

New Corporate Member

The Laister-Kauffmann Aircraft Corporation of Saint Louis has recently become a Corporate Member of the Institute. Based on the experience of the company, its officers, and key personnel in designing and flying gliders, the company has specialized in designing and building training and cargo gliders. It received from the Government one of the largest contracts for the TG-4A training gliders, and it is also participating in the production of the CG-4A troop and cargo-carrying glider.

The organization has also designed and developed its own version of a cargo and troop-carrying glider. This aircraft is reported to have passed all required static tests and flight tests and is now ready for production. In addition to these activities, the company is extensively engaged in reclaiming CG-4A gliders that have been used in this country for training air-borne units for combat service. It is one of three glider manufacturers selected for this assignment.

New Membership Emblems

New membership emblems, so designed as to enable the Institute to provide a separate emblem for each grade of membership, will soon be available.

These new emblems will make possible the identification of the various grades as follows:

Honorary Fellows and Fellows: Black lines on a gold background.
Associate Fellows: Gold lines on a black background.
MEMBERS and Industrial Members: Black lines on a silver background.
Technical Members: Silver lines on a black background.
Affiliates: Silver lines on a white background.
Student Members: Gold lines on a white background.

The emblems for the grades of Associate Fellow, Technical Members, Affiliates, and Student Members are the same as those used previously. The new membership emblems for Honorary Fellows and Fellows and for MEMBERS and Industrial Members will be sent on request, without charge. These grades of members are requested to return any emblems they may have at the time of making their request.

National Air Transport and Fall Meetings

For the information of members and readers, the following account of the two past National Meetings includes the available abstracts of the papers presented in the Technical Sessions. The complete program of each meeting is given.

Each of the papers presented will be considered for publication in forthcoming issues of either the JOURNAL OF THE AERONAUTICAL SCIENCES or the AERONAUTICAL ENGINEERING REVIEW. A limited number of preprints of those papers marked with an asterisk (*) are available for distribution to company libraries. Only one set of preprints will be made available to companies or their divisions at a mailing and handling charge of $0.25 per preprint. Individuals desiring copies of the papers should write directly to the authors.

Air Transport Meeting

The National Air Transport Meeting was held in the Hotel Statler, Washington, D.C., on the afternoon and evening of Friday, October 20, 1944. Approximately 400 members and guests attended the two Technical Sessions. The program of the meeting follows:

2:00–5:00 P.M. Federal Room

Chairman: Otto E. Kirchner
American Airlines, Inc.

A Study of Possible Glider Uses in Commercial Operations—Albert E. Blomquist, Major, Air Corps.

The experience gained in the design of utilization of gliders for military operations is sufficient to indicate the possible commercial applications of gliders and to establish the design criteria for cargo gliders.

The glider can be employed to expand the limits of efficient performance of a majority of the present and future transport aircraft and can, when used in conjunction with properly designed tugs and pickup gear, bring the advantages of air transportation to vast areas not now served by any well developed net of either ground or air transport.

A casual review of the transportation nets of various sections of the world indicate that only the United States, parts of Canada, England, and Europe have fairly well developed systems of communications and transportation. In China, other sections of Asia, parts of Russia, Australia, Africa, and Central and South America, the road and rail nets are not well developed, and air transport has brought service to only a small segment of the areas that could be served efficiently by air.

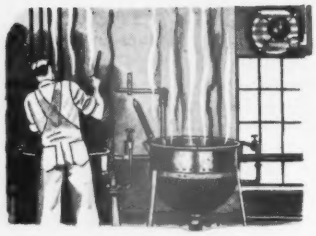
There have been some instances of the use of air transportation to open hitherto inaccessible areas, particularly in Central and South America and Canada. In no case has this means of transport been properly exploited or have gliders been considered as a means of efficient air operations in difficult terrain.

The military developments have been carried to a point where the different techniques of towed flight, free flight, landings in restricted areas, and pickup are well defined. The information available on military operations when coupled with a thorough knowledge of existing types of air service can be used as a basis for determining the application of gliders to commercial transportation requirements.

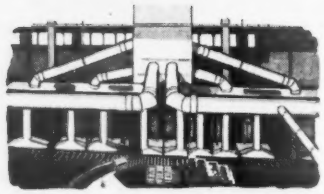
It is not the purpose of this paper to present a detailed analysis of glider uses. Such a presentation would take consider-

It pays to be "Nosey" about your Plant Air!

1. IF THERE ARE ANY innocent-looking vapors hanging around your plant—it will pay you to take another look at them. They may be costing you money. Smoke, steam and fumes have a way of slowing down workers . . . corroding equipment and even affecting the quality of finished products.

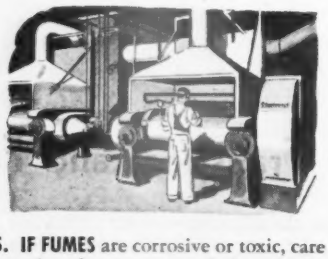


2. BUT REMEMBER, there's a lot more to fume control than just slapping a fan in the wall to exhaust air outside. The trick is to pick up fumes at the source—as soon as they are released—and to do it with minimum heat loss and operating expense.



3. FIRST STEP then, is installation analysis. One process may call for a single fan drawing through a system of ducts. Another set-up may call for an individual fan unit for each hood. In either case, provision for replacement air must be studied.

4. HOOD DESIGN comes next. Hoods should be placed as close as possible to the source without inconveniencing workers or hindering the process. And if hoods must be elevated, Sturtevant Engineers have worked out the exact degree of increase in hood size required for maximum efficiency.



5. IF FUMES are corrosive or toxic, care must be taken to prevent leakage in the system and corrosion of the fan and other equipment. Valuable elements in your fumes can be reclaimed handily. One Sturtevant System collects gasoline vapor from process with the result that 60% is recovered.

6. TO GET RID of fumes effectively—at lowest cost—equipment must be geared to *your* processing, designed by men who know all the ins and outs of fume control. Sturtevant Engineers—with experience in hundreds of fields, with all types of equipment to draw on—can give you unbiased recommendations.

Set your sights—*NOW* to forge ahead on conversion day

SOLID PRODUCTION GAINS will fall to manufacturers who plan now with Sturtevant for better fume exhaust after Victory. Elimination of employee health menace . . . more efficient workers and working conditions . . . equipment protected against corrosion . . . these results of engineered air are bound to strengthen your competitive position. Have your post-war planning committee get Sturtevant recommendations now—for "Putting Air to Work" in your plant on V-day.

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Mechanical Draft

able research. It is proposed, however, to present a review of possible applications of air train operations to commercial air transportation, that can be used as a guide to further investigations of the subject.

***A Review of the Aerodynamics of Flight Load Factors in Relation to the Safety Regulations**—Hugh B. Freeman, Consolidated Vultee Aircraft Corporation.

This article reviews briefly the aerodynamics of light load factors. An equation for the minimum maneuver load factor is proposed for planes in the transport category, based on the gust stalling speed and a "turbulent air maneuvering speed range."

For a value of 25 m.p.h., this equation yields load factors in good agreement with past experience. Suggested flight tests for the experimental determination of the turbulent maneuvering speed range would answer the question as to whether load factors could safely be lowered. The equation applies to flapped as well as unflapped wings.

It is concluded that the existing formula for maneuver load factors, based on power loading and gross weight, should be abandoned for a more rational equation based on the dominant parameters of the airplane, i. e., wing loading and aspect ratio. A more reasonable lower limit for the maneuver load factor would be that imposed by a horizontal turn at an angle bank of 60°. This limit could be reached only by airplanes with wing loadings much higher than any now contemplated.

Decreasing Landing Time Losses in Air Line Operations—James G. Ray, Vice-President, Southwest Airways Company.

Speed is still the greatest asset of flying and it is the overall speed that counts. Today, the three air lines competing for New York to Los Angeles traffic average 118 m.p.h. in aircraft that cruise at 180 m.p.h. The aviation industry is getting dangerously close to overall air speeds, which do not offer a sufficient margin over possible streamlined trains and superhighway automobile travel to win and hold a substantial volume of traffic. Air line schedules should be speeded up by using faster airplanes, especially designed to aid in the second of the two methods of improvement, decreasing the time lost at landing stops. This problem will be more difficult in the years after the war as we expand air transport to a much larger number of cities and towns. Basic design of the aircraft should place the fuselage horizontal and close to the ground by use of a tricycle gear to facilitate loading and unloading passengers and cargo. Still greater timesavings could be made by establishing improved operating procedures, eliminating the necessity for traffic circles above airports, long taxies and on-course landings and take-offs wherever possible. Requirements of an airport for the improved aircraft and its complementing set of procedures become much less. For smaller terminals, a single runway will be sufficient in most cases.

7:30–11:00 P.M.
Federal Room

Chairman: T. P. Wright
Civil Aeronautics Administrator

New York City's International Airport at Idlewild—Jay Downer, Consulting Engineer, Airport at Idlewild.

This discussion covers the layout and detail design for New York City's Municipal Airport at Idlewild. It describes the location, runway layout, accessibility, and operating characteristics of the field, as well as pavement designs, drainage and grating problems, lighting and other utility systems, safety provisions, anticipation for future expansion, and miscellaneous design and construction features.

***Developments in Air-Traffic Control**—Glen A. Gilbert, Chief, Air Travel Control Division, Civil Aeronautics Administration.

The control of air traffic has two main purposes—providing separation between aircraft as required to prevent collision and avoiding delays to the movement of aircraft because of traffic congestion.

Since safety must be provided at all times, the effectiveness of the air-traffic control system is determined by the *efficiency* with which the movement of aircraft is accomplished. Today aircraft can be landed at an airport during instrument approach conditions at the rate of but five per hour. This rate obviously must be substantially increased if the efficiency of the air-traffic control system is to meet the demands of present and future air transportation.

The Civil Aeronautics Administration has under way a four-point program of developments that will raise the capacity of the present air-traffic control system by at least four times. This program will provide only temporary improvement, however, and more far-reaching developments must be accomplished in the relatively near future.

Developments in the field of international air-traffic control also are now under way. These include the formulation of Air Traffic Rules for International Air Navigation and International Air Traffic Control Practices. Ultimately visualized is a uniform system of air-traffic control covering all areas in the world where air traffic is of such proportions as to require this service.

The air-traffic control problems of the future can be solved if certain additional developments materialize. These include devices in the aircraft and on the ground to permit delegating to the individual pilot responsibility for maintaining safe separation from other aircraft. With such devices, pilots will need to follow only simple "rules of the road," and the emphasis of air-traffic control will be shifted from the prevention of collisions between aircraft to the maintenance of efficiency in air transportation by providing for a smooth and well-regulated flow of air traffic.

Emergency Equipment for Commercial Transoceanic Flight Operations—William H. Hall, Transatlantic Division Engineer, American Airlines, Inc.

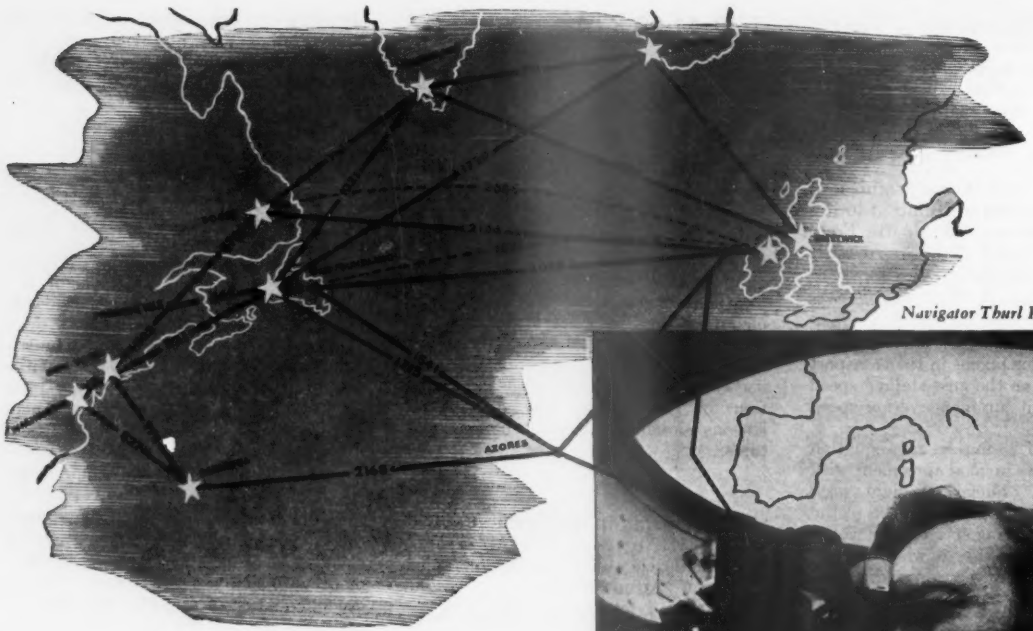
Existing regulations governing commercial operation on over-ocean routes are currently being revised to include, among other things, provisions for life rafts, life preservers, and other emergency equipment. Such equipment now available for use on commercial and military overwater operations imposes a great weight and space penalty on the carrier. Considering that there are over 30 applicants for overwater routes and that many contemplate using aircraft with passenger capacities reckoned in scores, it is highly desirable that emphasis be put on the development of lightweight, compact, and efficient emergency equipment. It is the purpose of this paper to outline the requirements that must be met and to discuss plans for the development of emergency equipment to meet such requirements. Attention will also be given to the stowage of such equipment with emphasis on reasons for the accommodation of such equipment in aircraft design. The benefits of standardization of emergency equipment will be discussed, and a plan will be suggested for accomplishing such standardization. Proposals brought up in the paper have developed as the result of research work and conferences with United States and Allied air-sea rescue organizations, branches of the Army Air Forces, emergency equipment manufacturers, and commercial operators.

***Lighting Equipment for Adverse Weather Operations**—W. T. Harding, Major, Air Corps; Assistant Chief, Electrical Branch, Equipment Laboratory, Wright Field.

The safety that is inherent in the operations of the present day commercial airlines is well known to the traveling public. This safety of operations, however, is attained at the expense of regularity of operations.

Flights are delayed, or cancelled, either because of weather conditions enroute or, more usually, because of weather conditions at the terminal airports. Although the interruptions or delays to regularly scheduled flights on an annual basis may be less than 5 per cent, these irregularities in schedules should be reduced as they are highly inconvenient to the traveler and costly to the air lines. It is not suggested that these irregularities be decreased at the expense of safety. It is suggested, however, that the problem be analyzed in an effort to correct this difficulty without impairing the safety record that now exists.

Lighting equipment developed by the Army Air Forces is being utilized at advanced bases as an aid for operations, either day or night, under adverse weather conditions. Service experience with this equipment, which is described and illustrated, has been favorable. The steps necessary to make this aid available for commercial operations are presented.



Navigator Thurl Ravenscroft of TWA

"used almost exclusively by TWA The TRANSCONTINENTAL Airline on all transoceanic flights"

Ask any navigator, whose calculations have controlled the fate of trackless transoceanic flights, how he feels about aerial sextants. Invariably he'll answer that a sextant is more than an instrument of precise measurement. It's something you trust — or don't. It has to do with air-instinct. Something known only to men who know the skies.

Ed Bolton, chief navigator of the far flung routes of the TWA Intercontinental Division says, "Our navigators use Fairchild Aerial Sextants almost exclusively on all transoceanic flights. They are dependable, rugged, compact, accurate."

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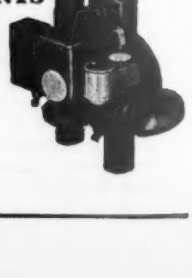


National Fall Meeting

The National Fall Meeting was held in the Auditorium of the Engineers' Club of Dayton, Dayton, Ohio, on the afternoons and evenings of November 9 and 10, 1944. The four sessions were well attended; an average of 130 members were present at each of the Technical Sessions, and approximately 200 members were present at the presentation of The Thurman H. Bane Award to Col. Donald J. Keirn on Thursday preceding the evening session.

The following twelve papers were presented:

Thursday, Nov. 9, 1944, 2:00 P.M.

Chairman: Bradley Jones
Professor in Charge of Dept. of Aero. Engineering, University of Cincinnati

Radio Noise in Aircraft Engines—Capt. Alfred E. Teachman, Air Corps, Aircraft Radio Laboratory, Engineering Division, Wright Field.

The growing importance of radio equipment in aircraft operations, both commercial and military, requires the complete elimination of engine ignition radio noise. This is shown to be entirely possible. Characteristics of the ignition impulse and its radio frequency effects are outlined. It is shown that resonant oscillations in the ignition system occur above 10 megacycles and that resistance wire cable markedly reduces the intensity of these oscillations. Filters for magneto grounding circuits are found to have a limited value in the V.H.F. range. Shielding concepts and the fundamentals of shielding design are presented with emphasis on the problem of obtaining continuity of the shield at joints and parting surfaces. Conducting gaskets of various types are described and the conditions which they must satisfy to achieve shielding effectiveness are stated. Some recent tests show wide differences in shielding effectiveness of flexible shielding conduit. Practical testing methods for the design engineer are suggested.

Aircraft Engine Gauge Unit—C. H. Ridgley and J. L. Theisen, General Electric Company, West Lynn Works.

The engine gauge unit for aircraft is a combination of three indicating instruments in a single case. The measurements made are oil temperature, oil pressure, and fuel pressure—three fundamental conditions of a gasoline engine which need to be checked at intervals and as quickly as possible.

The physical appearance and mechanical design of the engine gauge unit have changed several times since the first one was used. The latest form conforms to present-day requirements for standardization of size and shape and to new specifications for performance.

The temperature indication is obtained with a remote electrical system. The pressure indications are obtained with direct-reading mechanisms, with pipe lines transmitting the actual pressures to the instrument. The fuel pressure gauge is a differential indicator using pressure-sensitive diaphragms.

Advancements in engine gauge unit design to meet new specifications and to facilitate quantity manufacture have been in keeping with the general advancement in aircraft instrumentation.

Operational Methods in Servomechanism Design—William E. Restemeyer, Assistant Professor of Mathematics and Mechanics, College of Engineering and Commerce, University of Cincinnati.

An important class of automatic control devices whose use is not restricted to any one field is that known as servomechanisms. Defined technically, a servomechanism is an automatic control system having a controlling element actuated by some function of the difference between the actual and desired response of the controlled element. By the use of operational methods in handling physical transients, the servo systems are readily analyzed and quantitative design characteristics obtained.

It is the purpose of this paper to show the use of the Laplace Transformation in the analysis and design of servomechanisms. The treatment is divided into three main parts: (a) the fundamental theory of servomechanisms, (b) the Laplace Transformation, and (c) application to a simple servomechanism.

Because of military secrecy, the most interesting applications are restricted and cannot be treated publicly. For this reason, the subject matter of this paper is based entirely on accessible literature, and the example chosen is typical of applications in various fields including the military.

Thursday, Nov. 9, 1944, 8:00 P.M.

Chairman: Charles S. J. Mac Neil, Jr.
Chief Engineer, Aeroproducts Division, General Motors Corporation

Potentialities of a Capacitance Measurement Method for Fuel Quantity Gauges in Aircraft—C. F. Savage and D. B. Pearson, General Electric Company, West Lynn Works.

Methods employing capacitors make available several possibilities in the field of fuel quantity measurements, particularly in aircraft applications, which are not usually present in the conventional float type of remote-indicating liquid indicators. A method using electric condensers in the fuel tank is described and the potentialities of such a system are discussed.

A comparison is made between various features of float type and capacitance type gauges, pointing out some of the advantages and disadvantages of each. The effects of temperature, different gasolines, airplane attitude, and sudden changes in airplane attitude are discussed.

Fairchild K-8 Gunsight—Erwin Hale, Project Engineer, Fairchild Camera and Instrument Corporation.

The Fairchild K-8 Gunsight is an "electrical brain" used in aircraft gun turrets to provide automatically for correct deflection between line-of-sight and machine gun to insure hits on enemy aircraft. The gunner has only to keep the target enclosed within the reticle of the gun sight and, by so doing, the electrical units of the sight are set in motion to compensate for all factors affecting the course of the bullet in flight with relation to the moving target.

All such compensations are computed instantaneously, a feature of great importance when dealing with target speeds of 300–500 m.p.h. and bullet velocities of 2,700 ft. per sec. This electronic unit is particularly adaptable for complex problems involving several variables difficult or impossible to handle by mechanical means. It is also of potential use in post-war developments.

Electronic Controls in Aircraft—Lieutenant Ray J. Colin, Jr., Air Corps, Equipment Laboratory, Engineering Division, Wright Field.

(No abstract available)

Friday, Nov. 10, 1944, 2:00 P.M.

Chairman: John R. Weske
Professor of Aerodynamics, Case School of Applied Science

Fuel Quantity Measurement Problems—A. J. Snyder, Assistant Project Engineer, American Airlines, Inc.

The purpose of this paper is to discuss the problem of fuel quantity measurements as applied to long-range air-transport airplanes. The present trend in the use of integral fuel tanks throughout the span of the wings has introduced new problems in accurate fuel quantity measurements. An analysis of all existing measuring devices indicates that the present systems fail to meet fuel quantity measuring requirements for future long-range airplanes. The errors are not inherent in the measuring systems themselves but are largely caused by variations in specific gravity of the fuel, installation tolerances of measuring devices, tank calibration errors, changes in flight attitudes of the airplane, and the volumetric expansion of fuel due to temperature changes encountered in high-altitude flying.

Electrical Flight Control—Major L. M. Applegate and Lieutenant V. H. Quayle, Air Corps, Equipment Laboratory, Engineering Division, Wright Field.

Modern aircraft development is toward larger and larger aircraft. The problem of providing control for these aircraft is subject to serious study as the ordinary control levers cannot be operated by the pilot without undue physical strain.

This same problem has been encountered and solved by the railroad, automotive, and marine industries, using mechanical, electromechanical, and electro-

I. A. S.

National Meetings Schedule

1944–1945

January 30–31, February 1, 1945
THIRTEENTH ANNUAL MEETING — NEW YORK

April 26–27, 1945
SPRING MEETING — DETROIT, MICHIGAN

May 16–19, 1945
JOINT MEETING WITH THE SOCIETY FOR EXPERIMENTAL STRESS ANALYSIS — BUFFALO, N.Y.

July, 1945
ANNUAL SUMMER MEETING — LOS ANGELES, CALIF.

October, 1945
AIR TRANSPORT MEETING — WASHINGTON, D.C.

The Officers and Council of the Institute invite participation in the Technical Sessions of the Meetings of the Institute.

The Meetings Committee will consider for inclusion on the program complete papers, or outlines or summaries of proposed papers.

Information for Participants

(1) Complete papers, or outlines or summaries should be submitted in triplicate at least four months prior to the meeting at which it is proposed to present the paper. Outlines or summaries should not exceed 1,000 words.

(2) Each paper should be so planned that it may be presented within a time limit of 45 minutes.

(3) All papers submitted will be considered for publication in the **Journal of the Aeronautical Sciences** or the **Aeronautical Engineering Review.** While a paper should be planned to take only 45 minutes for presentation at a meeting, the written presentation may have a maximum length of approximately 15,000 words.

(4) All material received will be submitted to the Meetings Committee. Authors will be notified, in ample time to prepare the complete paper, whether or not their papers can be scheduled for presentation.

All correspondence should be addressed to

The Meetings Committee
Institute of the Aeronautical Sciences
1505 RCA Building West
30 Rockefeller Plaza
New York 20, N. Y.

pneumatic control systems designed to fit their particular applications.

At the present time Electrical Flight Control is represented by Automatic Pilots that can fly ships on a straight and level course. Manual control may be superimposed on the Automatic Pilot system by the pilot when such action becomes necessary.

One of the many design obstacles that must be overcome is, perhaps, a psychologic problem involving the pilot's "feel" of his aircraft and his ability to "fly by the seat of his pants." The use of the Electrical Flight Control system will isolate the pilot from actually "feeling" the air pressure on the control surfaces in response to movement of the control column. Synthetic devices to simulate this "feel" are used, although their value is still subject to debate by those concerned.

This paper is primarily concerned with the actuating units (servo motors) and the control features of the entire system. An analysis of the extra weight involved in the various control systems discussed is also made.

***Some Design Considerations of Electrohydraulic Power Supply Systems**—W. C. Trautman, Chief Hydraulic Engineer, Pacific Division, Bendix Aviation Corporation.

This paper concerns itself with such considerations as: (1) An explanation of purpose of an electrohydraulic power supply system; (2) pertinent advantages of such a system compared to unipower systems; (3) a review of the several control systems that can be used in such power supply systems; (4) application conditions which bring out the advantages of a dual-power system; and (5) the prediction of future trends which may be expected. Full cognizance of the relative newness of this type of system is noted, and only those systems which are in use, or being considered, are discussed.

Careful attention is drawn to the fact that, while advantages can be realized from such a system, it is not applicable to every accessory problem in aircraft. The limitations are enumerated for guidance in individual investigations where usage is being considered.

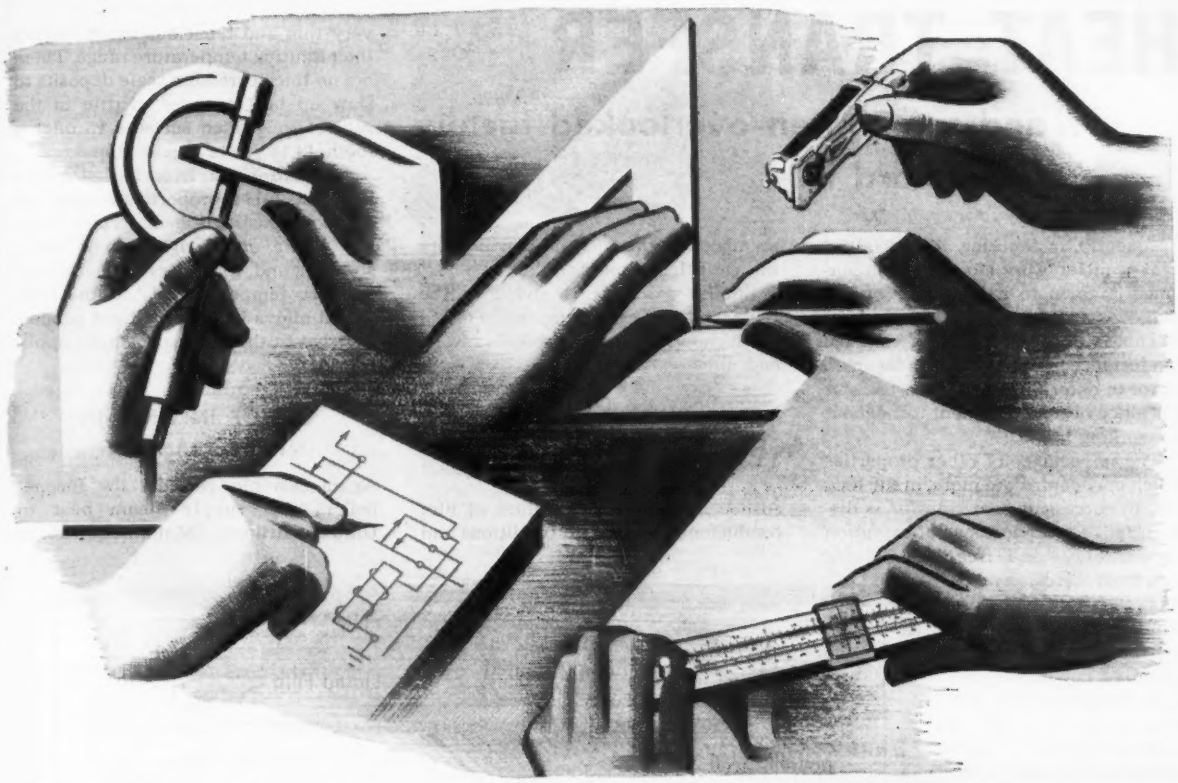
Particularly in large aircraft, the progressive development of such systems as a function of aircraft development is clearly indicated.

Friday, Nov. 10, 1944, 8:00 P.M.

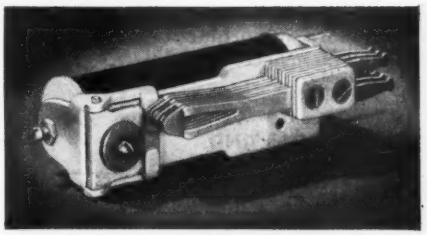
Chairman: Richard M. Mock
Vice President, Lear Incorporated

The Radio Navigator—S. B. Littauer, Receiver Engineering, Bendix Radio Division, Bendix Aviation Corporation.

In current practice, intelligence from a magnetic compass and from single or dual ADF are taken separately. The full value of radio navigation is only realized when this information is properly combined in order to yield other desired data. This procedure is greatly simplified and the effectiveness, and scope of radio navigation is greatly increased when this process



Your New Product may need the Magic of Electrical Control



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HEAT TRANSFER

...and some often-overlooked factors that retard it

Frequently, in choosing a material for heat transfer work, too much importance is given to its *thermal conductivity*.

This is done in the belief that the conductance of the material is the main factor in determining the heat transfer efficiency of the equipment throughout its working life.

The importance of other properties which may contribute more, in the long run, to successful heat transfer is disregarded. The importance of *oxidation resistance* . . . and freedom from corrosion products . . . for example, are often overlooked.

In actual service under corrosive conditions and high temperatures, the clean surface provided by rustless, corrosion-resistant materials such as the INCO Nickel Alloys is often more important than the thermal conductivity rating.

CORROSION AND HEAT TRANSFER

Materials that corrode build up jackets of scale. Such coatings permit relatively little heat to pass through.

The same heat-deadening effect is produced by films that form on metallic walls heated to oxidizing temperatures, and by films of heating or cooling gases that cling to metallic walls roughened by oxidation. Both the corrosive scale deposits and the gas films act as insulators rather than conductors.

This is shown graphically in the accompanying sketch. Note how the films and corrosion scale slow up the heat transfer rate. They make relatively unimportant the thermal conductivity rating of the metallic wall.

Similar evidence is given by the table which shows a comparison of the conductance ranges for metallic walls and films.

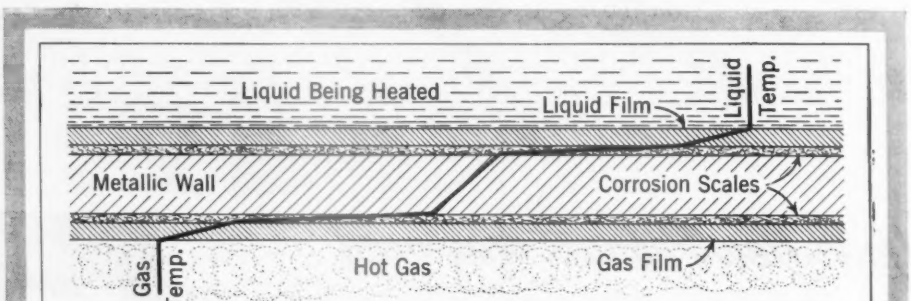
TABLE OF COMPARATIVE HEAT TRANSFER VALUES

Although the absolute values of film conductances vary with conditions and can be determined accurately only by experiment in each application, their relative values are of the magnitude shown in the accompanying table. Conductance ranges for metallic walls one inch and 0.025 inch thick also are given for comparison.

A study of the sketch and the table confirms the statement that, in many heat transfer jobs, the oxidizing characteristics of a material are fully as important as its thermal conductivity and its high-temperature mechanical properties.

COMPARISON OF THE CONDUCTANCE RANGES FOR METALLIC WALLS AND FILMS

Nature of Obstruction	Conductance Range Btu./hr. sq. ft./° F.
Metal wall	
1 in. thick	75 to 3,000
0.025 in. thick	3,000 to 120,000
Condensing vapor	1,000 to 4,000
Evaporating liquid	500 to 2,000
Liquid being heated	50 to 500
Liquid being cooled	40 to 400
Gas being heated	5 to 50
Gas being cooled	5 to 40
Corrosion scale	5 to 20



A section through a metallic wall transferring heat from a hot gas to a cooler liquid, showing gas and liquid films, corrosion deposits, and the general effect of each upon the temperature gradient.

CORROSION RESISTANCE OF INCO NICKEL ALLOYS

Nickel and high-nickel alloys offer a wide range of thermal conductivity. Monel, Nickel and Inconel develop very thin and tenacious oxides within their limiting temperature range. There are no thick corrosion scale deposits to slow up heat transfer . . . little in the way of roughened surfaces to offer a foothold to gas or liquid films.

In addition, the INCO Nickel Alloys have the other properties needed by aviation construction materials. They are *strong* and *tough* . . . they *retain* strength and toughness at both high and low temperatures. And the individual alloys have specialized properties that fit them for specialized applications.

USE OF INCONEL IN HEAT TRANSFER

As an example, consider the Inconel boilers that supply steam heat to United Airlines' "Mainliner" cabins. Installed in the engine exhaust stacks, they are exposed to the blast of corrosive gases at 1500° F. They must also resist the shock of inrushing water at 200° F. . . . a difference of 1300° F. on the inner and outer surfaces of the thin Inconel wall. Yet, despite these destructive factors, and the incessant vibration, Inconel boilers give hundreds of hours of completely satisfactory heat transfer service.

For further information about Heat Transfer, important to designers and builders of aircraft, write today for the INCO technical bulletin, "Heat Transfer Through Metallic Walls." Address:

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NICKEL INCO ALLOYS

is made automatic. By the introduction of the Universal Indicator, the Flux Gate Compass and ADF are integrated into one system yielding directly, on one indicator, true heading, true radio bearing, drift angle, and wind angle, among other functions.

By means of the automatic indications thus obtained, it is possible to double the customary "homing" range of the ADF, apply drift corrections directly, and obtain fixes rapidly. Information is thus automatically provided by the one indicator for computing ground speed, solving "bow and beam bearing," "doubling on the bow," wind star, and triangle of velocities problems. In addition, track angle navigation and other methods are made possible. By means of the Universal Indicator the Flux Gate-ADF combination in effect becomes a complete Radio Navigator.

Electrical Equipment for Aircraft—Lieutenant Colonel T. B. Holliday, Air Corps, Equipment Laboratory, Engineering Division, Wright Field.

(No abstract available)

***Electrical Retraction Systems**—Lieutenant H. M. Taylor, Air Corps, Equipment Laboratory, Engineering Division, Wright Field.

(No abstract available)

News of Members

Peter Altman, for many years head of the Aeronautics Department of the University of Detroit and, recently, Engineering Consultant in Detroit, has become associated with Aeronca Aircraft Corporation as Consulting Engineer.

Seymour M. Arkawy has joined the Fleetwings Division of Kaiser Cargo, Inc., as Wing and Tool Group Leader.

Gilbert C. Best is now with Consolidated Vultee Aircraft Corporation as a Stress Analyst.

Richard J. Cerny has transferred to Consolidated Vultee Aircraft Corporation as a Flight Test Analyst in the Flight Research Department.

Bela K. Erdoss received the degree of Ph.D. in Mechanical Engineering from Lehigh University.

William S. Holmes has been commissioned an Ensign in the U.S. Naval Reserve.

G. Sumner Ireland has been appointed Eastern Representative of the Sales Promotion Section of the Contracts Department of Curtiss-Wright Corporation, at New York.

Marion S. Israel has joined North American Aviation, Inc., as Engineering Designer (Preliminary Design).

Julius Jonas has been appointed Power Plant Engineer at the Fort Worth Division of Consolidated Vultee Aircraft Corporation.

Frederick J. Knack, recently engaged in engineering and production work with Fairchild Aircraft Division of Fairchild Engine & Airplane Corporation, has been elected Vice-President in Charge of Engineering at Luscombe Airplane Corporation, thereby rejoining the Luscombe organization of which he was Vice-President and Chief Engineer in 1937.

Joel Whitney, director and manager of the Ryan Aeronautical Institute, has been named new chairman of the San Diego Section of the Institute of the Aeronautical Sciences. A member of the Ryan organization for the past 4 years, Mr. Whitney is an engineering graduate of the Massachusetts Institute of Technology. Before his affiliation with the Ryan Aeronautical Institute, he was for 2 years a technical instructor of Army Air Forces aviation cadets, in connection with the Ryan school's primary pilot training program for the U.S. Army. Mr. Whitney is a MEMBER of the Institute.

Maria Z. Krzywoblocki has received the degree of Doctor of Aeronautical Engineering from Brown University, Providence, R.I. He is now a Fellow of the University.

Sol Love has joined Chance Vought Aircraft Division of United Aircraft Corporation as Assistant Project Structural Engineer.

Josef Medwecki has been appointed Deputy Chief Designer at the Prenco Progress and Engineering Corporation, Limited, of Canada.

Paul W. O'Meara has become a member of the staff of Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics, as an Aeronautical Engineer.

Charles N. Paxton has been advanced to the rank of Commander in the U.S. Naval Reserve.

John H. Prenzlau is now Management Engineer and Consultant with Whiting Associates, Inc.

Julius D. Schetzer has joined the faculty of the University of Michigan as Assistant Professor of Aeronautical Engineering.

Carlton E. Sisler, Jr., has received his commission as an Ensign in the U.S. Naval Reserve.

George B. Thorp, formerly Professor of Aeronautics at the University of Texas and, more recently, an Engineer with Arens Controls, Inc., has returned to academic work as Lecturer in Aeronautics at the Northwestern Technological Institute of Northwestern University.

Thomas S. Vallette has joined American Airlines, Inc., as Operations Agent.

Richard F. Vollmer has been appointed Manager of Power Plant Design at Goodyear Aircraft Corporation.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Foottit, Harold Raymond, Squadron Leader, Royal Canadian Air Force.

Elected to MEMBER Grade

Bachman, Rudolph Emil, Project Engineer, Specialties Inc.

Binder, Raymond Charles, Ph.D.; Prof. of Mech. Engineering, Purdue University.

Boyer, Capt. Jimmy Vinson, A.C.; Member Standardization Board, U.S. Army Air Forces.

Burroughs, Kenneth Leland, B.S.; Vice-President and Director, The Aeronautical University, Inc.

Carter, Leo Alexander, M.S. in C.E.; Asst. Manager (Oklahoma City Plant), Douglas Aircraft Co., Inc.

Crunden, Allan Bernard, Jr., Major, Chief, Tactics Section, Aero Medical Dept., A.A.F. School of Applied Tactics.

Dewees, Norman Branson, M.Sc. in Engineering; Project Engineer, Pesco Products Co.

Downey, Hugh C., Field Engineer Stratos Corp.

Fairbanks, Karl Joseph, M.S. in Ae.E.; Acting Chief Field Engineer, Development Div., Fairchild Aviation Corp.

Fennema, Frederick Frakes, B.S. in M.E.; Operations Analyst, Operations Analyst Section, U.S. Army Air Forces.

Gossard, Myron Lee, M.S. in C.E.; Sr. Stress Analyst, Curtiss-Wright Corp.

Hawkins, Kenneth Courtney, B.S.; Manager, Special Projects Div., Bechtel-McCone-Parsons Corp.

Herbolsheimer, Albert John, M.D.; Asst. Chief, Aviation Medical Div., C.A.A.

Ingalls, David, Chief Engineer, Titeflex, Inc.

Linsley, Horace Edgar, Technical Advisor to Public Relations, Wright Aeronautical Corp.

Martin, Robert Levin, B.S. in Ae.E.; Asst. Project Engineer, Bechtel-McCone-Parsons Corp.

Muir, Roy Cummings, B.S. in E.E.; Vice-President in Charge of Engineering, General Electric Co.

Paton, Clyde Raymond, B.S. in M.E.; Chief Engineer, Packard Motor Car Co.

Perlowski, Roy Adam, B.S. in Ae.E.; Design Engineer, United Air Lines Transport Corp.

Delco-Remy
Aircraft Electrical Equipment

Over coastline, forest country and plains, auxiliary "eyes" of the armed forces peer earthward—eyes of the Civil Air Patrol. The job they are doing is an unselfish routine of volunteer air hours, tedious tasks, courier service and assembly maneuvers . . . essential to national security, and contributing much to the progress of aviation in years to come.

More than half of Delco-Remy's facilities are now engaged in the manufacture of electrical units, precision parts and products for the aircraft industry. The efficiency and dependability of Delco-Remy electrical equipment in military planes of all types qualify it for service in cargo ships, airliners and the private planes of the future.

ARMY E NAVY

DELCO-REMY

WAR BONDS WILL BRING THEM HOME SOONER

DIVISION, GENERAL MOTORS CORPORATION

Price, Edmund Taber, B.S.; President and General Manager, Solar Aircraft Co.

Rowe, Norbert Edward, B.Sc.; Director of Technical Development, Ministry of Aircraft Production (England).

Ryan, Tubal Claude, President and General Manager, Ryan Aeronautical Co.

Salmon, Benjamin Tyler, Chief Engineer, Ryan Aeronautical Co.

Thompson, Walter Edwin, B.S. & C.E.; Stress Analyst, Consolidated Vultee Aircraft Corp.

Vilas, Jack, Asst. to the President, The Pyle-National Co.

Welmers, Dr. Everett Thomas, Ph.D.; Flight Research Engineer, Bell Aircraft Corp.

Werner, Ernest H., B.S.; Aeronautical Engineer of Safety Rules, C.A.B.

Williams, George Kissam, Ph.D.; Asst. Prof. of Aero. Engineering, Georgia School of Technology.

Transferred to MEMBER Grade

Flax, Alexander H., B.Ae.E.; Chief of Aerodynamics and Stress Analysis, P-V Engineering Forum, Inc.

LeBeck, Robert Keenan, B.S. in Ae.E.; Capt., U.S. Army Air Forces.

Elected to Industrial Member Grade

Frontario, Carmelo Anthony, Chief Procurement Inspector, A.A.F. Matériel Command, War Dept.

Hackley, Sherlock Dresser, A.B., Vice-President and General Manager, Fleetwings Div., Kaiser Cargo, Inc.

Lockwood, Preston, President, Brewster Aeronautical Corp.

Marshall, Jack Curtis, Asst. General Manager, Commonwealth Aircraft Co.

Powers, Michael Matthew, Chief Sub-Contract Engineer, Airplane Div., Curtiss-Wright Corp.

Vedral, Anton Frank, Asst. Wing Technical Inspector, U.S. Army Air Forces.

Elected to Technical Member Grade

Bley, Marvin, F., Lt., Engineering Officer, War Dept.

Bulmer, Malcolm Waite, Station Manager, Alaska Airlines (Alaska).

Eoannou, Angelo, "B" Layout Draftsman, The Glenn L. Martin Co.

Fleishman, Louis John, Asst. Chief Flight Engineer, Latin American Div., Pan American Airways System.

Foster, Gerald V., B.S.; Aero Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Godoy, Enrique, M.S. in Ae.E.; Jr. Engineer, Pan American Airways System.

Hack, Victor Frank, Lt., B.S. in Ae.E.; Asst. Operations Maintenance Officer, U.S. Army Air Forces.

Hunton, Lynn Wood, Jr., B.S.; Associate Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Kelley, George Mortimer, Jr., Sr. Loftsman, The de Havilland Aircraft of Canada Ltd.

Klunker, Emil Bernard, B.S. in M.E.; Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Leizer, Matthew Robert, Asst. Leader, Wing Group, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Monroe, Neal Curtis, Group Leader, Consolidated Vultee Aircraft Corp.

Nemerever, William Joseph, M.Sc.; Detail Engineer, Boeing Aircraft Co.

Norton, Elizabeth Frances (Miss), B.S. in L.S.; Asst. Technical Librarian, Hughes Aircraft Co.

Ridgway, Robert Coulter, B.S. in Ae.E.; Jr. Engineer, Pacific-Alaska Div., Alaska Sector, Pan American Airways, Inc.

Rusler, George Wilbur, B.S.; Jr. Design Engineer, Minneapolis-Honeywell Regulator Co.

Sheridan, Hugo Grotius, B.S. in Engineering, Draftsman, The Glenn L. Martin Co.

Sherman, Earl L., B.S.; M.E.; Jr. Engineer, Aircraft Engine Research Lab., N.A.C.A.

Shur, Ira, B.A., Project Engineer, Simmonds Aerocessories Inc.

Sloan, Lloyd Hamilton, Power-Plant Engineer on the Design Staff, Canadian Vickers Limited (Canada).

Taylor, Fen Cannon, Aerodynamicist, Boeing Aircraft Co.

Warshaw, Victor, Layout Draftsman, Edo Aircraft Co.

Wheelock, John Robert, Aerodynamicist, Douglas Aircraft Co., Inc.

Wherry, Thomas Kenneth, Lt., Engineering Officer, U.S. Army Air Forces.

Transferred from Student to Technical Member

Anderson, Adrien Ely, B.S. in Ae.E.; Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Becker, Joseph, B.S. in Ae.E.; Private, U.S. Army Air Forces.

Bruno, Joseph Frank, B.Ae.E.

Bucher, Raymond Kasper, B.S. in Ae.E.; Asst. Engineer, Lockheed Aircraft Corp.

Burt, John Arthur, B.S. in Ae.E.; U.S. Navy.

Caruso, Mario Anthony, B.Ae.E.

Chamberlain, James Drummond, A.B. in Engineering; Ensign, U.S.N.R.

Chen, Chia-Tseng, B.S. in Ae.E.

Decker, James L., B.S. in Ae.E.; Jr. Aerodynamicist, The Glenn L. Martin Co.

Eales, Edward Prescott, B.S.; Aero. Engineer, (Research), Langley Mem. Aero. Lab., N.A.C.A.

Edwards, Samuel Sherman, B.Ae.E.; Aviation Cadet, U.S.N.R.

Fadem, David, Engineering Draftsman, Chance Vought Aircraft Div., United Aircraft Corp.

Flora, Clarence Conrad, B.Ae.E.; Apprentice Engineer, Grumman Aircraft Engineering Corp.

Heinrich, Robert Gustav, B.S. in Ae.E.; Jr. Engineer, Grumman Aircraft Engineering Corp.

Hill, Robert Allan, B.S. in Ae.E.; Engineer, D.W. Onan & Sons.

Hunter, Robert Linton, B.S. in Ae.E.; U.S. Navy.

Kircher, Lawrence George, B.S. in Ae.E.; Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Laux, Edward Grant, Jr., Engineering Draftsman, Chance Vought Aircraft Div., United Aircraft Corp.

Nelson, Robert Leslie, B.S. in Ae.E.; Pvt., U.S. Army Air Forces.

Reed, Chester L., B.S. in M.E.; Structures Research, Lockheed Aircraft Corp.

Reed, Thomas Ansley, B.Ae.E.; Ensign, U.S. Navy.

Shanks, Bernard J., B.Ae.E.; Engineering Asst., Douglas Aircraft Co., Inc.

Simpson, Donald Mosteller, B.Ae.E.

Stevens, John Erwin, B.S.; Research Asst., Massachusetts Institute of Technology.

Tetenman, Norman William, Engineering Draftsman, Chance Vought Aircraft Div., United Aircraft Corp.

Thornbury, Kenneth LeRoy, B.S. in Ae.E.; Midshipman, U.S.N.R.

Winegarten, Alvin, Engineering Draftsman, Chance Vought Aircraft Div., United Aircraft Corp.

Elected to Affiliate Grade

Bosold, Donald Dolan, Lt., Naval Aviator, U.S. Marine Corps Reserve.

Caldwell, Tracy Fairfax, Process Analyst, Consolidated Vultee Aircraft Corp.

Cheney, J. Burleigh, President, Skyway Corp.

Pelka, Edward Joseph, Service Representative, Airplane Div., Curtiss-Wright Corp.

Valentin, John Edward Conrad, Jr., Draftsman, Tool Design and Engineering Dept., Columbia Aircraft Products Inc.

Wishart, David, Engineering, Draughtsman, The De Havilland Aircraft of Canada Ltd.

Necrology

Roland E. Dufrene

Lt. Roland Ellsworth Dufrene of the Army Air Forces, a Technical Member of the Institute, was reported by the War Department to have been killed in an aircraft accident on August 3, 1944. He was 24 years of age.

Lieutenant Dufrene was graduated as a Bachelor of Aeronautical Engineering from the University of Minnesota in 1942. He was commissioned a Second Lieutenant in the Army Air Forces and was assigned as an Aeronautical Engineer in the Structures Department at Wright Field, Dayton, Ohio. He had received his license as a private pilot.

Daniel C. Green

Daniel Crandall Green, Chairman of the Board of Cleveland Pneumatic Tool Company and Cleveland Pneu-

ANSWERING SOME HELICOPTER QUESTIONS

The past century has witnessed the development of the telegraph, electric light, telephone, automobile, airplane, radio and many other industrial marvels, which are still in the process of transforming living conditions throughout the world. And today there is wide enthusiasm over *another* revolutionary development—the helicopter . . . and wide curiosity concerning *its* future possibilities.

Therefore it is timely to publish a sincere and factual appraisal of the helicopter and an informed statement of the part it may play in future progress. As one of a dozen or more substantial and conservative industrial organizations engaged in helicopter development—the oldest in the rotary wing field—Kellett Aircraft Corporation accepts this opportunity to present some helicopter facts and to state the opinions of its management and engineering staff on the future of the helicopter.

DEVELOPMENT HAS BEEN RAPID

Today, in the United States, a half dozen or more different helicopter types are flying. To the best of our knowledge, helicopters are flying in no other country, and only in the United States is effective research and production being carried on. This is largely due to the sponsorship received from our military services during the war period.

WHAT CAN HELICOPTERS DO?

The helicopter, as a matter of normal flying operation, can rise straight into the air from a standing start; land in the same way; hang motionless in the air at low altitude over a given point for as long as the pilot wishes; fly backwards as easily as your automobile reverses; move directly sideways; fly safely inside a large auditorium.

ARE HELICOPTERS EASY TO FLY?

The men who pilot helicopters today are carefully trained, experienced men. Flying a helicopter is not a job for a novice. Many controls must be coordinated and the pilot must possess excellent skill and judgment. However, these "experts" are otherwise average individuals and one or two of them had never had experience in flying before they stepped into helicopters. It is reasonable to expect that "ease of flying" will be improved with further engineering developments.

WHAT WILL HELICOPTERS COST?

Helicopters, if they could be purchased on the market today (which military requirements will not permit), would be more expensive than the most costly automobile. Engines, intricate transmissions, control mechanisms and rotor blades require special design and construction methods. Helicopters are likely to be costly for some time to come. Of course, if the efficiency of mass production and the competitive enterprise system are permitted to have their effect, the cost is certain to come down.

ARE HELICOPTERS SAFER?

It has not yet been demonstrated that a helicopter is any more safe or less safe than other aircraft. Conventional airplanes have established impressive records for safety.

WHO WILL USE HELICOPTERS?

It is our belief that helicopters will have their first important usefulness in fields where other forms of transportation cannot serve. In many situations the helicopter will introduce important savings of time, manpower and money. For instance, in the spraying of agricultural crops, inspecting and servicing of cross country oil pipe lines and electric transmission lines; forest and shore patrol; prospecting; in mail and passenger service to areas otherwise inaccessible by air.

WILL HELICOPTERS BE FAST?

As aircraft, helicopters today are not very fast. To a world which accepts 400 m. p. h. flight as commonplace, they may never become "fast" aircraft. BUT the helicopter's as-a-crow-flies travel is much faster than automobile or train transportation, and even faster in some cases than the combination of land and plane travel which present-day air transport entails. The practical helicopter will not require a trip to an airport as a necessary preliminary to a flight.

WHAT ABOUT HELICOPTER CAPACITY?

Helicopters are still in the medium-power, cabin class. It may be some time before a type will develop which will cruise more than a few hundred miles without refueling or which will carry more of a load than a sedan.

HOW RAPIDLY WILL HELICOPTERS BE PERFECTED?

As in the case of the airplane, development of the helicopter is a matter of engineering. The present-day airplane is the result of many millions of engineering-man-hours over a period of years. The present-day helicopter is the result of several hundred thousand engineering-man-hours over a period of years—inconsequential as yet, compared with the engineering applied to the airplane of today. Over the years to come, additional millions of engineering-man-hours must be expended in order that the helicopter shall make its maximum contribution to progress. How soon that goal is reached depends on the rapidity with which the engineering investment can be made.

KELLETT HELICOPTERS

Kellett Aircraft Corporation has been a designer and builder of rotary wing aircraft for fifteen years. We have confidence in our ability to provide after-the-war helicopters which will be practical for many commercial uses. We look forward to widening fields of service—along with other aircraft manufacturers—in a better, happier, more air-minded future. Kellett Aircraft Corporation, Upper Darby (Philadelphia), Pa.

KELLETT

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY

matic Aerol, Inc., died on July 2, 1944. He was an Industrial Member of the Institute.

Mr. Green was born near Patriot, Ind., on November 16, 1884, and was graduated from Purdue University with the degree of Bachelor of Science in Electrical Engineering in 1908. A large part of his business career was devoted to the electric light and power industry. During the period from 1910 to 1933, he was Manager, General Manager, and Vice-President of various public utilities properties in the H. M. Byllesby and Electric Bond & Share groups in the western states and New York City. In 1933 he was elected President and Trustee of the Middle West Utilities Company in Chicago. In 1937 he organized the Central Service Corporation in Chicago and served as its President. Early in 1941 he was appointed by the Federal District Court as Receiver and a member of the Joint Board of Management and Operation of the Chicago Surface Lines.

In March, 1942, Mr. Green was elected Chairman of the Board of the Cleveland Pneumatic Tool Company and served as the Chief Executive Officer of that company and its affiliate, Cleveland Pneumatic Aerol, Inc., until his death.

James H. Ullett

Capt. James Howard Ullett of the U.S. Army Air Forces was reported deceased by the War Department on October 26, 1944. He was 24 years of age and was born in East Sparta, Ohio, on January 21, 1920. He attended Tri-State College, majoring in aeronautical Engineering, and entered the Army Air Forces as a Flying Cadet in 1941. Captain Ullett was a Technical Member of the Institute.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Aircraft Power Plant Staff Engineer—Minimum five years' experience on power-plant design and thorough knowledge of thermodynamics. **Aircraft Production Cost Estimator. Aircraft Engineers**—Experienced aerodynamicists, stress analysts, weight engineers, layout draftsmen and senior detailers. Applicants must comply with W.M.C. regulations. Write full details of qualifications to McDonnell Aircraft Corporation, 1703 Locust St., St. Louis 3, Mo.

Aeronautical Engineer—Six years' experience, rotor wing aircraft experience desirable, power-plant installation or some design and structural layout experience necessary. Address inquiries to Mr. Enea Bossi, Higgins Industries Incorporated, New Orleans 19, La.

Detail & Layout Draftsmen, Stress Analysts, Design Engineer, Assistant Project Engineer on development work in the engineering department. Address inquiries to Edo Aircraft Corporation, 136-48 Roosevelt Avenue, Flushing, L.I., N.Y.

Graduate Engineer—Draftsman—Excellent immediate and postwar opportunity. Design airplane accessories. Aeronautical experience necessary. Particular reference to work in hydraulics and alighting gear. Engineering draftsman, with or without aeronautical background, also desired. Write direct, stating education, experience, age, and draft status to Mr. Robert D. Spencer, Manager, Aeronautical Sales & Engineering Department, The General Tire & Rubber Company, Akron, Ohio.

Aeronautical Engineer—graduate or equivalent in experience. Good working knowledge of airplane design, structure, materials, and stress analysis desirable. Background of naval aircraft specifications and manufacture considered excellent. Pleasing personality is essential. Apply or write to the Bureau of Aeronautics Representative, c/o Edo Aircraft Corporation, 13-10 111 Street, College Point, N.Y.

Aircraft Engineers—Openings available in progressive Aircraft Company for layout and design engineers to cover Wing, Empennage, Power Plant, Fuselage, Electrical and Radio, Landing Gear, Hydraulics, Equipment, and Controls. Also openings for Tool Designers, Tool Planners, Production Planners, Loftsmen and Aircraft Drawing, and Template Checkers. Those presently employed in essential war work need not apply. Air mail complete detailed information regarding education, experience, salaries, former employers, age, family status, citizenship, and draft status, in order that we may be able to evaluate your qualifications from the first letter. Address inquiries Higgins Aircraft, Inc., P.O. Box 32, New Orleans 6, La.

Graduate Engineers for essential war work, opportunity for advancement and increased earnings. Aeronautical experience not necessary. Must be citizen, not employed in essential war industry, or have certificate of availability from the U.S. Employment Service Office or War Manpower Commission of your area. Write direct, stating school, age, degree, experience, draft classification, and marital status to Consolidated Vultee Aircraft Corporation, Industrial Training Division, San Diego, Calif.

Contact Man—to aircraft industry, travel mid-west and east representing manufacturer of heat transfer equipment. Engineering and previous contact with aircraft industry desirable but not essential. State background and previous employers and enclose photo. Address inquiries to Box 266, Institute of the Aeronautical Sciences.

Aero & Mechanical Engineers—Large engineering firm engaged in military work with growing backlog of postwar jobs needs engineering personnel in all categories: Designers, Layout & Detail Draftsmen, Stress Analysts, Checkers, etc. Location Manhattan. W.M.C. rules observed. Address inquiries to Box 263, Institute of the Aeronautical Sciences.

Chief Design Engineer—Graduate mechanical engineer, experienced on automotive radiators, with established AAA-1 high production manufacturer or automotive radiators. Worth-while salary. Sound peacetime future with resumption of automobile production. Write in complete detail. Enclose recent (nonreturnable) photo. Address inquiries to Box 252, Institute of the Aeronautical Sciences.

Industrial Engineers—Major coast to coast air line, strong background on accounting systems, operating cost accounting and capital items depreciation; must be willing to leave city. Permanent position offering unlimited opportunity. Describe background in detail. Enclose photo. Address inquiries to Box 240, Institute of the Aeronautical Sciences.

AVAILABLE

Aeronautical Engineer and Pilot—B.S. and M.S.E., Commercial Pilot, three years' experience in flight-test work involving handling characteristics of a variety of airplanes. Can get full release for position that involves flying. Would prefer position where engineering and flying can both be used. Address inquiries to Box 270, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Several years' experience in the design of both wood and metal air frames. Has served as Group Leader of Electrical Group. Thoroughly familiar with circuit work and aircraft electrical equipment. Permanently draft-deferred. Release from present position can be secured. Desires position with promise of postwar future and permanence with Eastern aircraft concern. Address inquiries to Box 269, Institute of the Aeronautical Sciences.

Pilot—Commercial, C.A.A. Instrument and Instructor ratings. Two Army Reg. 50-3 Instrument ratings. SeL 110–675 HP. Total 2,000 hours including 110 hours instrument time. 60 hours Link. Single engine (BT-13, AT-6), twin-engine and some primary trainer time. Graduate A.A.F. Instructor's School Instrument Pilot, Bryan, Texas. Experience teaching

SOUNDPROOFING WITH FIBERGLAS*

SAVES WEIGHT

FOR BIGGER C & S PAY LOADS

Released by the Army, transports like Chicago and Southern's "City of Little Rock" are being reconverted for commercial service by Douglas Aircraft Company.

The use of Fiberglas XM-PF, sound absorbing insulation, instead of the material previously installed, effects a weight saving of 50 pounds on each 21-passenger plane.

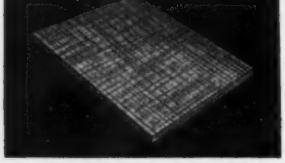
In addition to its high sound absorption, Fiberglas XM-PF, being made of glass fibers, is incombustible. And because it does not absorb moisture, it prevents added weight from accumulating in the inner lining of the ship under conditions of high humidity. It is resistant to vibration and can be applied to curved or flat surfaces. This efficient insulation material is made in large, flexible sheets, of various thicknesses, and is easy to handle, cut, fit and install.

In other forms, too, Fiberglas is serving the military and commercial aircraft industry in both new construction and reconversion work. Woven into textiles, Fiberglas provides a fireproof fabric for a number of specialized applications.

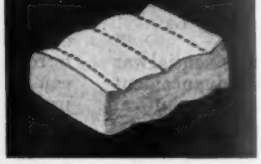
Still other types of Fiberglas textiles are impregnated, treated or coated to provide materials possessing a unique combination of mechanically, chemically and electrically important characteristics.

And, when used to reinforce certain types of plastics, Fiberglas permits the fabrication of exceptionally strong, lightweight, easily formed structural parts.

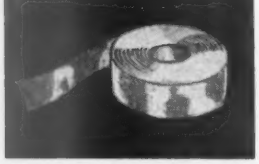
If you do not have complete data on Fiberglas in its various forms, write: *Owens-Corning Fiberglas Corporation, 1893 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*



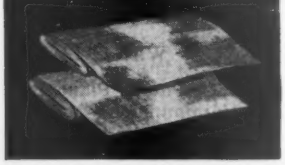
AIRCRAFT REINFORCED PLASTIC PARTS—fabricators are combining certain low-pressure resins with Fiberglas fabrics. Light weight, impact strength, sound dampening. Used for panels and formed parts.



AIRCRAFT BLANKETS—for thermal insulation. Fireproof. Made of Fiberglas insulating wool, faced and attached with Fiberglas cloth and thread. Available in 1½ lb. and 3 lb. densities.



AIRCRAFT TAPES—another all-glass product, woven from Fiberglas yarns. Incombustible. Used for insulating motors, generators, etc., for lagging of thermal insulations on ducts and pipes.



AIRCRAFT COATED FABRICS — used as a base for rubber, vinyl compounds and other coatings. Dimensional stability, high strength, humidity resistance. Used in flexible connections, etc.

FIBERGLAS

*T. M. Reg. U. S. Pat. Off.

instrument flying. Also 4½ years' engineering experience specializing in Weight and Balance control large aircraft manufacturer. One year's experience as aeronautical ground instructor. Aeronautical engineering education. Member Air Corps Enlisted Reserve. Desires flying job offering continued ERC status or deferment. Age 27, married, two children. Address inquiries Box 268, Institute of the Aeronautical Sciences.

Power Plant Development Engineer—Six years' experience in research, design, and development. Familiar with the aerodynamic, thermodynamic, and metallurgical aspects of gas turbine development. Address inquiries to Box 267, Institute of the Aeronautical Sciences.

Aircraft Factory Executive—Under 40; 17 years' aeronautical experience; broad background. Been Factory Manager, Research Chief, Quality Manager, and Chief Inspector for reputable U.S. aircraft manufacturers; also C.A.A. inspector. Experienced on rotating wing, amphibious, and conventional aircraft; Army, Navy, and Commercial standards; metal, wood, and plastic construction; modern managerial and production methods. Nine Federal Licenses. Proven research and inventive ability; some sales (about 50 airplanes), piloting (1,700 hours), radio (4 stations), and yachting experience. Want management position with progressive company (preferably making helicopters, amphibians, or private owner airplanes). Take up to 50 per cent of salary in company stock. Now in East. Statement of availability, and best of references. Address inquiries to Box 265, Institute of the Aeronautical Sciences.

Engineer-Test Pilot—M.S. in Physics, M.S. in Aeronautics. Two years' experience with aircraft manufacturer as test pilot and design engineer. Five years' experience air-line pilot; latter 2 years as air-line test pilot and Captain on transoceanic operations. Change contemplated because of termination of military contracts. Address inquiries to Box 264, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in M.E., M.S., 1½ years' experience in stress analysis of private airplanes, 6 years' experience in supervisory capacity with one major aircraft concern including 5 years of stress analysis and structural design of experimental and production Army and Naval aircraft and one year of static testing and structural research. Desires position in vicinity of New York City with consultant or with company having postwar plans for the development of personal airplane. Address inquiries to Box 262, Institute of the Aeronautical Sciences.

Engineer—Over 25 years' experience on airplanes, airships, aircraft accessories, mechanical devices, engineering investigations. Unusually broad and up-to-date knowledge of all metals, woods, glues, plastics, and finishes. Present executive position ends about November 1, due to curtailment of engineering. New York area preferred. Salary over $7,000. Address inquires to Box 261, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Graduate, 26 years old, 4½ years' experience in design and stress analysis of large all-metal airplanes. Desires position in or near Minneapolis, Minnesota, $4,500 year. Address inquiries to Box 260, Institute of the Aeronautical Sciences.

Electrical Engineer—Graduate, age 30, family. Eight years' experience leading aircraft companies in design and research on electrical, radio and instrument components. Five years as a section head in the above capacities. Thoroughly familiar with related aircraft engineering problems. Desires responsible position having good postwar possibilities. Prefers vicinity of Los Angeles, South America, or other suitable location will be considered. Address inquiries to Box 259, Institute of the Aeronautical Sciences.

Structural Aeronautical Engineer—Extensive experience in military and commercial aircraft development, and as design project engineer, desires responsible engineering position in air cargo development, or other postwar project in eastern or northeastern area. Release available, draft exempt. Address inquires to Box 258, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Varied design experience. Thoroughly familiar with light-plane field. Private pilot. For past two years have done development and sales engineering for aircraft accessories firm. Desire responsible position, West Coast. Address inquiries to Box 257, Institute of the Aeronautical Sciences.

Industrial Engineer—Broad and varied experience in Plant Layout, Tool Design, Tool Control, Methods, Procedures, Hours Control, Work Simplification, Cost Analyzation, Incentives and Reports. Wants responsible position; can go anywhere; now employed; can comply with W.M.C. Regulations. Address inquiries to Box 256, Institute of the Aeronautical Sciences.

Graduate Aeronautical Engineer—Two years with World Airline in South America, 3 years with a senior world aircraft manufacturer, desires position requiring tactful exercise of initiative and resourcefulness as assistant export sales executive; speaks Spanish and Portuguese fluently; travel anywhere. Address inquiries to Box 255, Institute of the Aeronautical Sciences.

Aircraft Engineer—Nine years in active aircraft operations, including two years loftsman, one year liaison engineer, one year supervisor of production engineering, two years engineering representative for all subcontracted parts of large West Coast manufacturer, one year research and development engineer for Rocky Mountain firm. All W.M.C. affidavits approved. Desires position of engineering trouble-shooting or representation, preferably foreign and tropical. Will also consider any reasonable Southern California offer. Address inquiries to Box 253, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. and M.S. degrees. Nine years' experience in structures, wind-tunnel testing weights, and flight testing. Have been chief of structures for three well-known manufacturers. Desire commensurate position with company having postwar possibilities. Address inquiries to Box 251, Institute of the Aeronautical Sciences.

Aeronautical Development Engineer—College graduate with six years' experience in design and development of commercial and military airplanes desires responsible position in small concern in executive or development capacity. Capable of taking complete charge of new projects. Present position, project engineer. Would consider air-line work. Address inquiries to Box 250, Institute of the Aeronautical Sciences.

Engineering Representative—Ten years' aircraft experience in supervision of departments and direction of projects, widely traveled, graduate Aero and Mechanical engineer and business training; desires permanent connection where engineering and business background can be utilized in sales or production; married, will travel. Address inquiries to Box 249, Institute of the Aeronautical Sciences.

Graduate Aeronautical Engineer—17 years of practical experience in military and commercial aircraft development, design, and supervision. Acted as consultant, project engineer, and designer in responsible charge of engineering work and personnel with major aircraft companies. Desires responsible and permanent position with aircraft company. Willing to accept position in South America or other suitable foreign country. Address inquiries to Box 245, Institute of the Aeronautical Sciences.

Mechanical-Aeronautical Engineer—5 years, major aircraft stress analysis. Desires connection with west coast airframe or accessories company. Address inquiries to Box 244, Institute of the Aeronautical Sciences.

Inspector and Production Engineer—5 years' experience in high-altitude fighter planes, desires employment with transport air line having postwar future. B.S. degree; linguist; any

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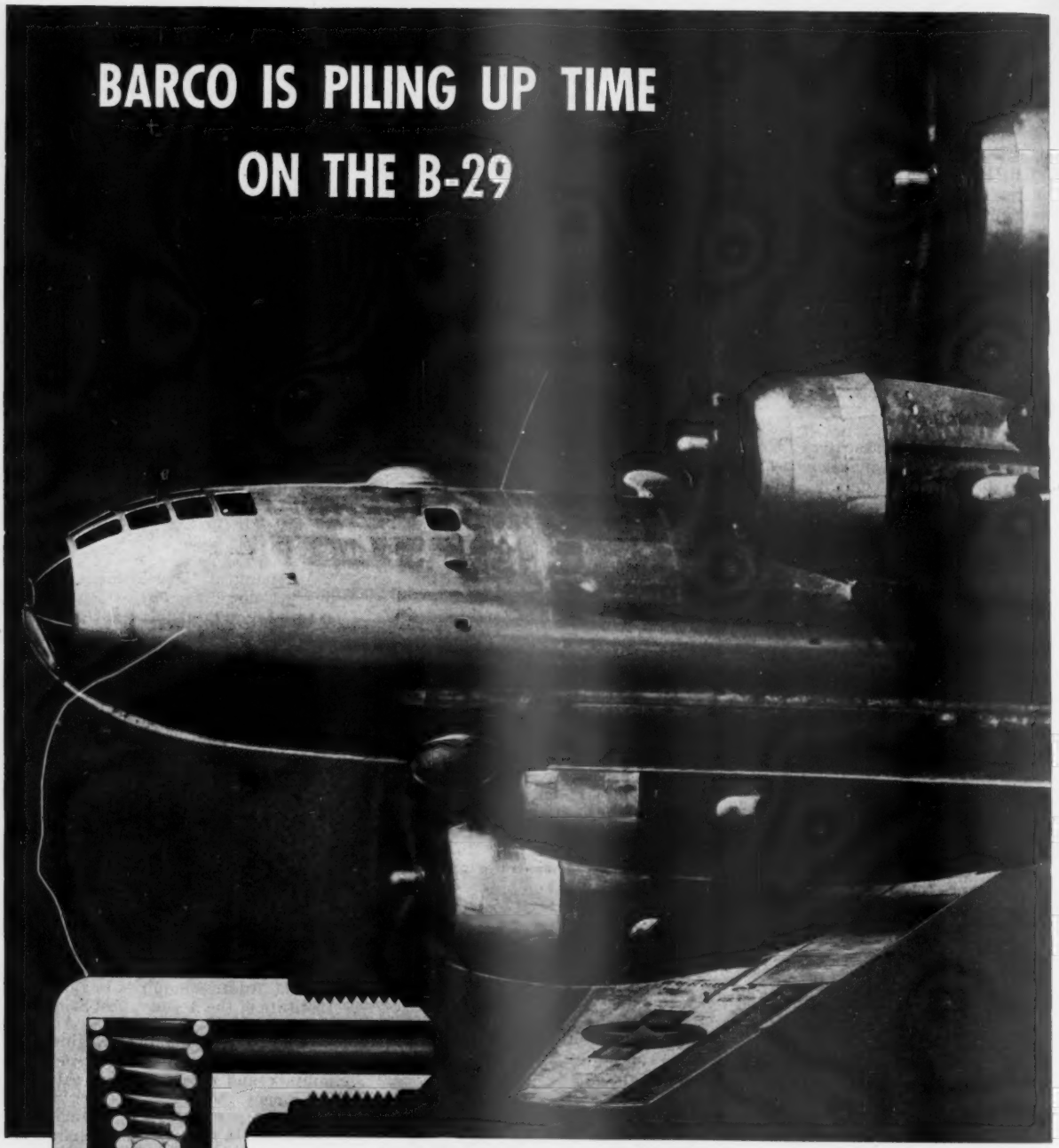

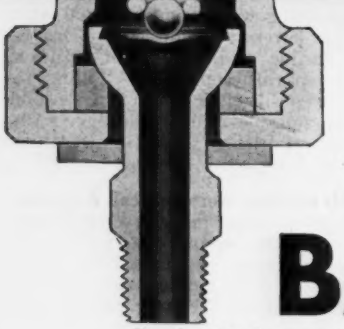

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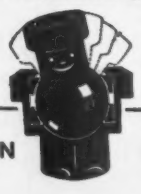

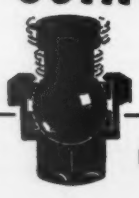

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location. Address inquiries to Box 237, Institute of the Aeronautical Sciences.

Layout Draftsman—21 years old, 2 years' experience in large aircraft factory in power plant and wing design; 2 years' experience tool and machine designing; recently honorably discharged from Army. Desire position with postwar future in large aircraft company, preferably in vicinity of New York. Address inquiries to Box 243, Institute of the Aeronautical Sciences.

Helicopter Project Engineer—Nine years' experience in aircraft engineering, composed of 1 year as project engineer, 6½ years as structural engineer and 1½ years as weight engineer. Desires position with a company sold on the future of this type of aircraft both for war and postwar use. Address inquiries to Box 242, Institute of the Aeronautical Sciences.

Consultant Aeronautical Engineer—Honorably discharged Army Air Forces, formerly executive Chief Engineer, Administrator, Designer desires new connections or additional consultant work. Preliminary aircraft design and jet propulsion specialist. Address inquiries to Box 205, Institute of the Aeronautical Sciences.

(*Continued from page 133*)

Electricity in Aircraft, by W. E. Crook; Sir Isaac Pitman & Sons, Ltd., London, 1942; 104 pages, 5*s*.

The second edition of this guide intended for those studying for the British Air Ministry "X" License contains no major changes. A section has been added dealing with carbon-pile voltage regulators thereby making more complete the treatment of voltage-control devices.

The author does not claim that all of the information needed for the examination is contained in this small book; he notes that practical experience and proof thereof are required before the license can be granted. However, an endeavor has been made to gather within these pages a large part of the information otherwise scattered over numerous books and pamphlets. Because space limitations have made it necessary to be as concise as possible, elementary electrical principles are treated with a view toward refreshing the student's knowledge, instead of attempting to teach something new.

The principal subjects are aircraft batteries; generators; engine starting; wiring and lighting; magnetos; miscellaneous electrical equipment; and impulse starters, automatic timing devices, and spark plugs.

A Treatise on the Mathematical Theory of Elasticity, by A. E. H. Love; Dover Publications, New York, 1944; 643 pages, $3.95.

The fourth and revised edition of a mathematical treatise on elasticity. Important additions to the book include a discussion of the theory of a rectangular plate, clamped at the edges and bent by pressure applied to one face; a discussion of the theory of the resistance of a plate to pressure when it is so thin that the extension of the middle plane, caused by deformation of that plane into a curved surface, cannot be neglected; and an account of the process by which stress-strain relations are deduced from the molecular theory of a crystalline solid.

An important revision concerns the theory of the equilibrium of a sphere. It has been found possible to simplify the easier parts of that theory considerably, thereby eading, by comparatively elementary methods, to the most important geophysical applications of the subject.

Gegossene Metalle und Legierungen (Metal and Alloy Castings), by Willi Claus and A. H. F. Goederitz; M. Krayn Technischer Verlag, Berlin, 1933; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 346 pages, $13.50.

A compilation of the charts representing the fundamental theoretical and technical principles of scientific foundry work, which were displayed during the Duesseldorf Foundry Exhibition in 1929. These charts were the result of years of painstaking research, and many visitors to the exhibition had expressed the desire that the information be made generally known. The main sections of the book are as follows: Theoretical and Applied Metallurgy; Technical Information About Metals and Alloys; Heavy Metals and Heavy Metal Alloys; Light Metals and Light Metal Alloys; Production.

Thermodynamic Charts, by Frank O. Ellenwood and Charles O. Mackey; John Wiley & Sons, Inc., New York, 1944; 46 pages, $2.75.

A revised edition of a book containing steam charts and charts showing the thermodynamic properties of water, ammonia, freon, and mixtures of air and water vapor. The book has been written to assist practicing engineers, teachers, and students in making calculations involving these fluids. Special tables for making turbine calculations are also included. These give the jet velocity from an ideal nozzle for each B.t.u. up to 599, and for each tenth of a B.t.u. up to 80.

SAE Handbook—1944 Edition; Society of Automotive Engineers, Inc., New York, 1944; 804 pages, $5.00.

S.A.E. Handbook, 1944, is the current annual edition of a book containing the standards and recommended practices of the society, consisting of standardized specifications, data, tables, and drawings of a great number of parts, materials, and fittings used in automotive and aeronautical construction. The book is arranged in ten sections, each of which begins with a title page giving the contents of the section. There is a directory of the different committees, their personnel, and the regulations governing their work. The aeronautical standards, material specifications, and other data pertaining especially to aircraft construction are published separately in complete form, but this volume includes 20 pages of specifications for certain aeronautical standards.

Sampling Inspection Tables, by Harry G. Romig and Harold F. Dodge; John Wiley & Sons, Inc., New York, 1944; 106 pages, $1.50.

Sampling inspection tables are presented. These were developed for use in the manufacture of communications equipment for the Bell Telephone System, but they have been found more widely useful and have already been adopted by several other companies.

Sections of the book discuss some of the factors to be considered in setting up inspection plans, single sampling, double sampling, the average outgoing quality concept, and the mathematical background of the tables.

Laboratoriumsbuch fuer die organischen Plastischen Kunstmassen (Laboratory Book on Organic Plastic Materials), by Emil J. Fischer; Verlag von Wilhelm Knapp, Halle, 1938; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1944; 96 pages, $3.35.

This is a chemical and analytical guide for chemists and technicians that deals mainly with pressed and cast hard plastics for use as insulation materials. Synthetic rubber, plastics with a glue or gelatine base, or plastics composed of materials containing keratin are not considered. The laboratory testing methods proposed in this book may be carried out by means of simple devices, and should offer no difficulties even to those who have little practical experience in making chemical analyses.

The test results will be sufficiently correct for practical purposes. One section contains an alphabetical list of the most important raw materials, fillers, and dyes used in the production of synthetic resins and other plastic materials.

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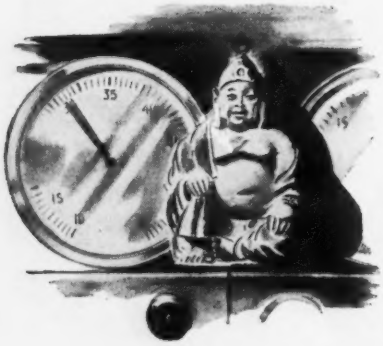

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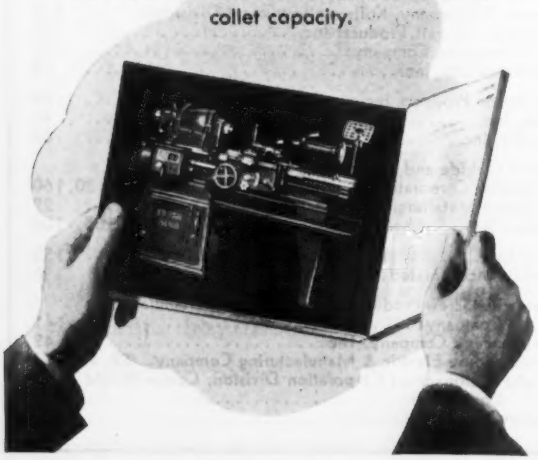

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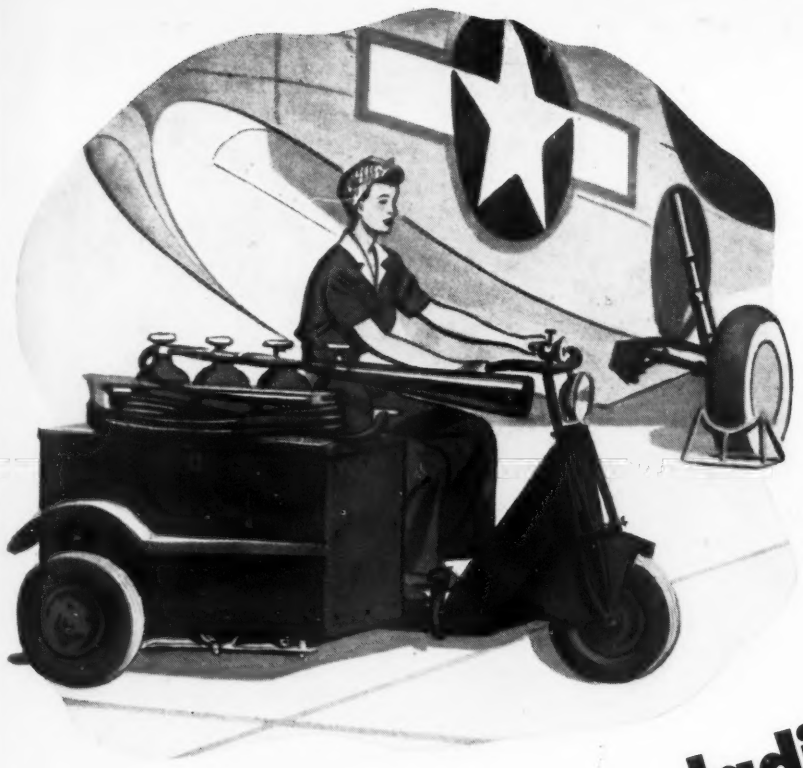

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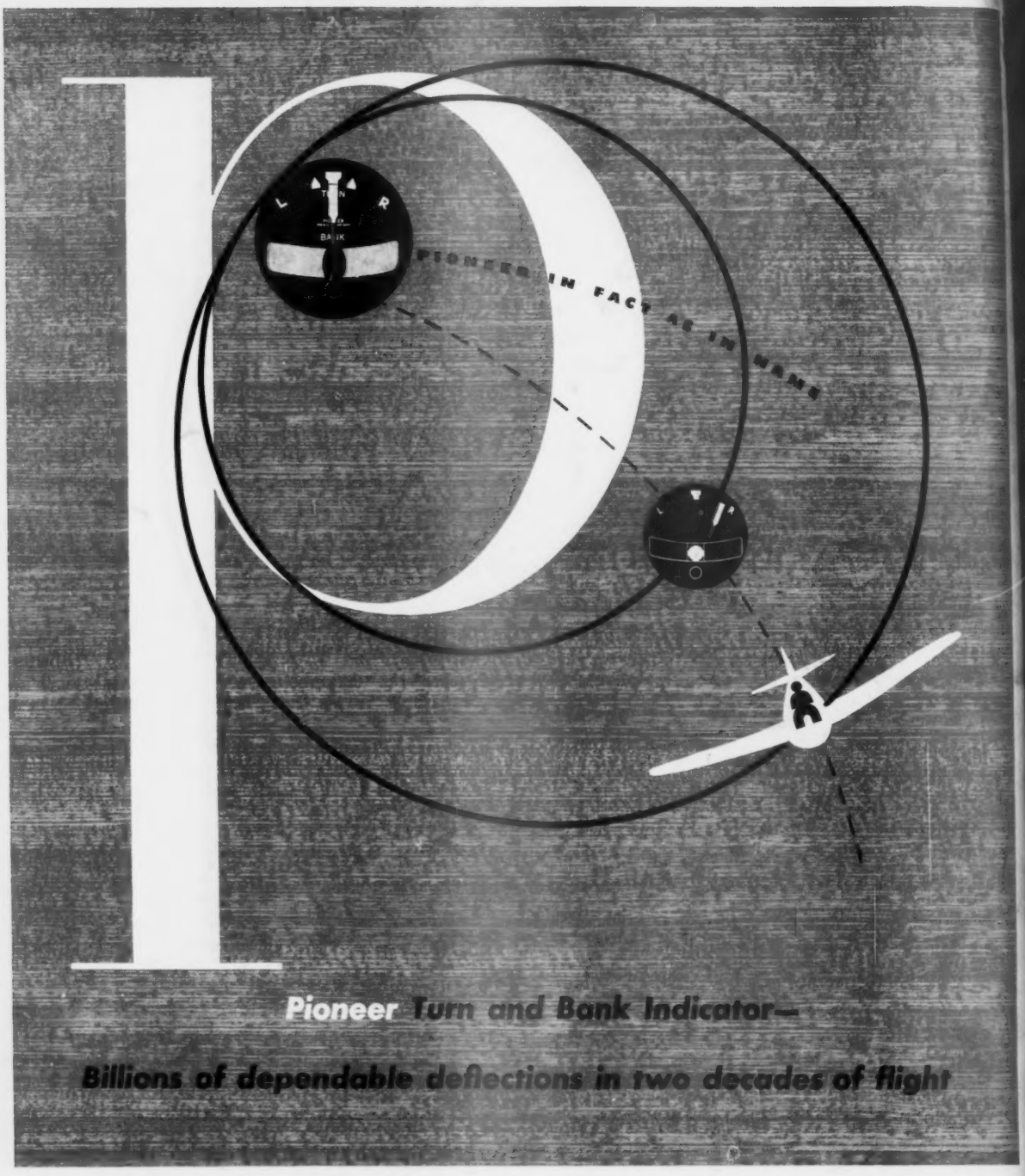

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